







**SELECTIONS FROM THE RECORDS OF THE BOMBAY  
GOVERNMENT.**

**No. XLV.—NEW SERIES.**

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**REPORT**

**ON THE**

**UPPER PORTION OF THE EASTERN NARRA,**

**ITS SOURCES OF SUPPLY,**

**AND**

**THE FEASIBILITY OF RESTORING IT AS A**

**PERMANENT STREAM.**



**Bombay:**

**PRINTED FOR GOVERNMENT**

**AT THE**

**BOMBAY EDUCATION SOCIETY'S PRESS, BYCULLA.**

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**1857.**





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## THE EASTERN NARRA.

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THE valley of the Indus, below its junction with the Punjab rivers, is an alluvial plain, bounded on the west by the mountains of Beloochistan, on the east by the sand-hills of the Desert. The uniformity of its surface is broken only by the low rocky ranges at Alore\* and Hyderabad, and by occasional sand-hills as we approach its eastern limits. The traces of ancient channels are everywhere met with, rendering it probable that there is no part of the alluvial plain over which, in the course of ages, the river has not flowed at some period. The cause and mode of these changes is detailed in the following paragraph; and the evidence of their occurrence, afforded by the appearance of the country, is confirmed also by the traditions to be found in the "Chuch Nameh" and other records of the earlier history of Sind.

General description of the Basin of the Indus.

2. It has been observed of all large rivers, and has been particularly mentioned by the Geologist Lyell, that the silt with which their waters are charged is deposited during the season of overflow most abundantly near the edge of the stream, and in a proportionally smaller quantity at a greater distance from it. It thus forms a natural glacis, the crest of which is on the river bank, and the slope falls away gradually towards the boundary of the valley. That the Indus is not an exception to this rule will be seen on reference to the Cross Section (No. 1) across the valley at Sukkur, and the Profile (No. 2) showing the relative heights of the Bhawalpoor road and of a line nearly parallel to it, ten miles inland. A continuance of this process would gradually raise the level of the river-bed, until, during some extraordinary flood, it should burst its natural embankment and take to one of the lower tracts, to be in its turn raised and deserted. In the mean time the cross section of the valley would present the general features of a raised central channel with a depression on each side.

Natural causes affecting the Cross-Profile of the Valley.

3. On the east bank of the Sutlej, from Rooper to near Bhawalpoor, a depression of this nature is met with, and is believed to extend in a course parallel to that of the Garra and Indus to Subzulcote, from the vicinity of which it has been traced to the head of the Eastern Narra, about eleven miles from the mouth of the river.

A depression parallel to the Indus on its left bank is the source of the Narra's supply.

4. A depression parallel to the Indus on its left bank is the source of the Narra's supply. A depression of this nature is met with, and is believed to extend in a course parallel to that of the Garra and Indus to Subzulcote, from the vicinity of which it has been traced to the head of the Eastern Narra, about eleven miles from the mouth of the river.

\* Alore and Arore are names (the former ancient, the latter modern) of the same town; both names are used in these Reports to describe the same spot.

miles east of Roree. It receives water from the river by direct overflow and through innumerable canals, and its drainage, though variously interrupted, is the source of the Narra's supply.

4. Each canal that crosses this low tract forms, by its embankments, an obstruction of more or less consequence, and bunds also are frequently raised to retain the water for agricultural purposes, and to form lakes for fishing. Immense tracts of land are thus submerged, and when one or two of the obstructions give way, the rush of the accumulated water is sufficient to sweep away all remaining impediments, and to send a large and sudden supply into the Narra; whereas if the bunds hold, no water reaches that channel except by percolation of the soil. Even the short time through which our observations extend, has afforded us satisfactory proof of the precarious nature of this supply. In November 1843, we saw in the channel opposite Trigadee evident and recent marks of a flood which rose  $17\frac{1}{2}$  feet above the then level of the stream; but during the inundations of 1844, a register of the water-gauge kept near the same locality shows 3 feet 11 inches as the greatest rise throughout the season.

5. It is stated by several writers, on Native authority, that the Narra has a separate head in the banks of the Indus, and that the supply of water was constant until this head was obstructed by a bund, described by some as being built of stone clamped with iron, and by others as being an earthen embankment. Neither this channel however, nor the obstruction commonly designated by the name of the "Alore" or "Arore Bund," could be discovered. Sir Alexander Burnes, indeed, (to whom the supposed bund was frequently mentioned during his investigation of the causes which led to a remarkable flood in the Narra in 1826) on the occasion of a subsequent visit to Roree supposed that he had found the bund, and described under that name the old masonry bridge across the canals near the ruins of Alore, but this work could never have had the effects attributed to the Arore Bund: it would tend to obstruct the flow of water through the hill to the southward, and therefore, to a small extent, might increase rather than diminish the supply of the Narra.

6. The traces of an ancient channel are still extant in continuation of the opening through the hills at Alore, and corroborate the tradition that the Indus held this course during the reign of Dahir, the last Hindoo sovereign of Sind. The position of the Narra renders it probable that it was then a main branch of the river, and if any works were constructed or attempted at the time of the change, they may have led to the belief, which has since so universally obtained, that the "Alore Bund" is the key of the Narra's supply. Perhaps, however, we may more reasonably suppose that under this name are included all the bunds alluded to in the 4th paragraph.

7. The defined channel of the Narra may be said to commence near the village of Fukeerabad, between which and Salehput

Detail of Drainage falling into the Narra.

it receives numerous ravines leading from the low tract of land north-east of Roree. On its own eastern bank, also, it has several contributions from among the sand-hills, many of which, on the outskirts of the Desert, are isolated and separated from each other by rich tracts of alluvial soil, subject to inundation, and covered either with thick jungle or luxuriant grass. Few of these were traced, but their debouchure into the Narra are met with for a long way down. A large channel of this nature is met with near the village of Janoojee, and another, called the "Raince," said to come from near Bhawulpoor, enters the Narra between the villages of Saida and Ratee, but of late years has not brought down any water. Below Trigadee the Narra also receives from the westward the drainage of the Alore range of hills.

8. From Fukeerabad to Janoojee the channel of the Narra is well marked ;

Description of the Channel of the Narra.

it is 20 feet below the level of the country, and from 300 to 600 feet wide. Throughout this distance it had a slender stream of fresh water in January 1844, which, however, appears to have ceased during the hot weather. Below Janoojee the channel changes its character, being more sandy, more irregular in its width, and less depressed ; below the level of the country it has no continuous stream, but good and fresh water is still found in pools, which are probably fed by an under-ground current. Below Ratore the channel widens still further, and divides into several branches, some of which are blocked up by shifting sand-hills; the pools of water become more scarce, but continue good as far as Tujjul, beyond which the Survey did not extend : but it was reported that the pools below that point are brackish.

9. The valley of the Narra from Salehput to Tujjul is very narrow, being

Description of its Valley as far as Tujjul.

bounded on the right by the Alore range of rocks and the sand-hills which form their southward continuation, and on the left by the sand-hills of the Desert. The inhabitants are few, and live principally by fishing. Traces of cultivation are rarely met with.

10. Below Tujjul the Narra appears, from Captain DelHoste's description,

Description of the Valley as far as Oomerkote.

to be confined between high sand ridges, but near Oomerkote the channel itself is described as hard and grassy.

11. A reference to the Profile taken along the Narra will show that the

Practicability of supplying the Narra permanently with Water from the Indus.

slope of its channel is nearly parallel to that of the Indus (the latter being marked by a strong blue line), but about 20 feet lower than its cold weather level. It is, therefore, evidently practicable to fill the channel of the Narra with a stream of water from the Indus.



12. With so great a difference, however, and which would be increased during the inundation, there would be reason for apprehension lest the channel of supply, excavated as it would be through a soft soil, should be so much widened and deepened by the action of the torrent as to drain off more water than could be spared from the Indus, or, perhaps, transfer the main stream of the river, with its fertilizing effects, from its present to one of its ancient channels.

13. A masonry head to the channel of supply would be a security against this evil; but the nature of the banks of the Indus is very unfavourable to the construction of such a work. There is no permanency in the bed of the Indus, which is always cutting one or other of its banks and throwing up shoals on the opposite one. The proposed head, therefore, would be exposed to the double risk of being turned and undermined by an encroaching current, or masked by miles of mud-bank and quicksand, requiring to be cut through after each inundation before the annual supply of water could reach the Narra.

14. The rock in the vicinity of Roree offers a site for the proposed work not liable to either of the above objections: with such a foundation the dam would be secure from the action of the stream, and the current which sweeps through the contracted channel would forbid any extensive accumulation of silt in front of the work.

15. The proposed work must be designed to answer the following conditions:—It must have a wide water-way at a low level to admit of an abundant supply of water during the cold weather, and it must also afford means of regulating the supply to be admitted during the inundation of the river. It must have a bridge of communication along the river bank, and also afford a free passage for boats between the two streams, with a provision for locks to be used when the difference of level between them is considerable.

16. The line of the proposed supply channel would pass between some of the detached rocks near Roree, and thence skirt the foot of the sand-hills which have collected against the rocks as far as the opening through the latter at Alore; through this it would follow the line of the Alore Canal till clear of the hills, and would then be carried by a more direct course into the Narra opposite Trigadee. The total length of this line is  $16\frac{1}{2}$  miles. If the proposed canal have an initial depth of five feet below the lowest water level, and its bottom be carried on an uniform slope to meet that of the Narra, it would have a slope of very nearly 1 foot per mile; at 670 yards from its head it would be cut through rock to a depth of 20 feet, but for a very short distance. It is possible also, though not probable, that rock would be met with in the passage

through the hills at Alore. The rest of the line would require an excavation varying in depth from 12 to 30 feet through a light soil.

17. The benefit likely to accrue to the British possessions in Sind from the restoration of the Narra would be confined to the Hyderabad Collectorate, as the channel would enter into the territory of his Highness Ali Moorad immediately after passing Alore. It is supposed, however, that there would be abundant use for the water in the neighbourhood of Oomerkote, and should the sand-hills on its right bank prove not to be continuous, it might be possible to lead canals from it into the dry lands north-east of Hyderabad.

18. The benefits to be derived from this measure by Ali Moorad are confined to the improvement of the valley of the Narra, which, with a steady supply of water, would afford abundant and excellent pasturage. Its capabilities for agriculture are few; but there are localities where the water might be turned to good account for the purpose. I may instance the west bank opposite Tuijul, where, it will be seen by reference to the Cross Section No. 3, there is an extent of seven or eight miles of level ground from the edge of the river to the foot of the sand-hills.

19. The Rao of Cutch also has expressed himself very anxious for the re-opening of the Narra, which, where it approaches his territory, takes the name of the Pooran. He anticipates from this source a compensation for the waters of the Goonee having been of late years prevented by obstructions from finding their way to the Luckput Creek, a subject which has already been reported upon. It is probable that, in consideration of these prospective advantages, both Ali Moorad and the Rao of Cutch would be willing to contribute a portion of the expense of this undertaking.

20. I have not data to calculate the cost of the work; neither the boring instruments for which I indented at Delhi, nor those for which I wrote at Kurrachee, arrived in time to enable me to ascertain the depth of sand in different places over the rock at Roree, and on this would depend the cost of founding the dam, &c. The supply channel would be the chief item of expense, but it would also be necessary to confine the water to one channel in some parts of the Narra, and prevent its running to waste among the sand-hills. In the Hyderabad District there would be further expenditure in digging canals from the river to the cultivated ground, but until the lines are chosen for this purpose no estimate of cost can be formed.

(Signed) W. BAKER, Captain,  
Superintendent of Canals in Sind.

*Kurrachee, 14th October 1844.*

No. 862 of 1850.

REVENUE DEPARTMENT.

From the COLLECTOR OF HYDERABAD,  
To the COMMISSIONER IN SIND.

SIR,—With reference to your letter No. 1895, of 2nd October 1849, calling for a promised report on the Narra Bund, I have the honour to submit, that though then acquainted, as I believed, with the main features of the case, I found, on going into it, that there was a great want of accordance in some parts of what I heard regarding it; so much so, that it seemed difficult to see my way with that exactness which must always be requisite to enable a person to report to useful purpose upon any subject.

2. A short time afterwards, your Assistant was kind enough to offer to let me see the report which Captain Baker had made in October 1844 upon the subject; but this only added to the obscurity, for it is quite clear that Captain Baker himself was misled, or, at any rate, that the bund he wrote regarding was a perfectly different one from that contemplated by myself, and the advisability of cutting through which I had reported so early as November 1843: this latter bund he most erroneously supposed to have no existence.

3. On this point, however, I was sure that he was wrong, for one of the very first things impressed upon me, after taking charge of this Collectorate, was the advisability of bringing to a conclusion the negotiations which had for some time been in progress regarding this bund's destruction; and it was impossible to suppose that, that could have been the subject of angry discussion between this and the neighbouring State, which, in point of fact, had no existence.

4. I therefore again sent for the person, whom, from his having seen the bund, I had found able to give me the best information about it, and who had also held an important Revenue office under Meer Sobdar, the Meer to whose share of the division of Sind among the Ameers the chief part of the land on the Narra fell. He was ill at the time and for some months subsequently, but he has since been able to go to Subzuleote and has traced the Narra down to Lower Sind and made a Sketch of it, copy of which, with a translation, I enclose. This Sketch, I believe, will be found to be perfectly accurate, that is, accurate after the fashion that all Native papers of the kind are, totally destitute of all proportion. The distances of the several places named, if measured with compasses, and compared with the known distance of each from the other, are outrageously absurd, but still, on the whole, answering the purpose it is intended for, of giving a correct notion of the spot and matter in special reference to which it has been prepared. In this particular (and in cases of this kind it is the main one) I generally find Native maps as truthful as any other.

5. It would appear from this and the report of my informant, that the Narra branches off from the Indus near the village of Ghosepoor, which is

built on the site of an ancient city, and lies in the territory of Bhawal Khan. The bed of the Narra is said there to be in places a hundred and twenty miles broad, and in that part it bears the name of Toorkuree, only taking the name of the Narra at a spot much lower down. It thus passes on below Subzul to the boundary of Upper Sind, and thereabouts is divided by a strip of land which forms an island about four koss long by two broad. This is totally uncultivated and covered with jungle; the channel to the east of this island is called the Rain, and that to the west Goorilla.

6. Below this island the two streams again become joined, and thence, onward to the bund, form a series of Doras, or lakes, all connected with each other by long channels between the extremities of each. The last of these, before we come to the bund, is called the Jerrur Doree, and here the stream first begins to be called the Narra.

7. At the spot where the bund is erected the Narra is stated to be about a koss broad, and the bund is made of earth and brushwood rammed well together, producing an almost impenetrable wall right across the whole bed of the Narra and of an average thickness of fifty yards. This bund is said to rise far above the banks on each side, and as these are, at that spot, of an earth particularly tenacious and almost as hard as stone, the result is obviated, which, at almost any other part, might be anticipated from such a work, viz. the cutting away by the stream of the banks round each end of the bund, until a new channel was cleared equal in size to that which had been blocked up.

8. This bund was made by Futeh Mahomed Ghoree, a man whose name will be familiar to every one who has read the papers connected with our early negotiations and subsequent taking of Sind. His object was to give an additional supply of water to his Jaghire of Birha, situated on the western bank of it.

9. The bund was erected in Khurreef 1249, corresponding to the year of our Lord 1838, and its pernicious effects were immediately felt in Lower Sind. The water in the lower part of the Narra, which had afforded a supply often great, always considerable, was cut off; no less than three hundred and sixty Colabs, or lakes, fed by it in Lower Sind were dried up; fisheries which had brought, in good years, some thousands of rupees of revenue to the Ameers were destroyed, and lands which had yielded as the Government share some hundreds of Kurwars became waste. But the mischief did not end here: more important matters than revenue were concerned. There was a considerable Belooch and Jhutt and Hindoo population along the Narra, and the important towns of Kippira, Loondra, Mitta Khan, Chotecaree, Sirenwarree, Mittrow, Syed Gholam Nubbee-ka-gote, and Oomerkote lie along its banks; and as the natural fertility of the soil along the whole valley is unrivalled, it may be imagined what distress the cutting off this, the main supply of water, must have occasioned. Numbers were in point of fact deprived of their means of subsistence, and many who had gained a sufficient support from the fish and wild fowl on the Narra, and from the grain and vegetables grown along its banks, were reduced to the

alternative of leaving the country or taking to those illegal methods to obtain a livelihood which the neighbourhood of every desert holds out alike such great temptations to and such great facilities for.

10. Meer Sobdar, whose lands were chiefly affected, immediately despatched a Vukeel, named Ghoolam Hoosein Juttohee, to Khyrpoor, who was instructed to remonstrate with Meer Roostum and obtain an order from him for the instant destruction of the bund. This he succeeded in getting from the Meer, but Meer Nusseer Khan of Khyrpoor afterwards induced Meer Roostum to suspend the operation of it, and Meer Sobdar's Vukeel himself, having been handsomely treated by the Khyrpoor Durbar, neglected to press the matter very strongly, and so the bund remained.

11. Meer Sobdar on this decided on turning Ghoolam Hoosein out of his service, and renewed the negociation through other channels; while, in order to give weight to his remonstrances, he ordered the several Kurriahs\* running through his dominions to the Jaghires of Meer Roostum in this Collectorate (Kohceera, Kotara, &c.) to be bunded up, and all supply of water to them to be thus cut off: the grain growing there he also had impounded, and these active measures appear to have been calculated to produce the required effect. But at this juncture war between the British and the Khyrpoor State broke out; other more important matters had to be attended to; the conquest of Sind was effected; and the bund remained.

12. One of the earliest measures adopted by me after receiving charge of this Collectorate, was to press upon Sir Charles Napier's attention the advisability of taking the opportunity to settle the matter and obtain the demolition of the bund. But Captain Baker was shortly afterwards appointed Superintendent of Canals in Sind: he was an officer who came here with the highest possible character from the Government under which he had previously served; the question was one that lay more immediately within his department; and I was informed, I think verbally, that the matter would be brought to notice, and that he would doubtless do whatever might be found to be at once feasible and proper.

13. His report on the subject I never saw till it was sent me by your Assistant. Had I done so, I might have had an opportunity of putting him right, for it is quite clear to me that he was misled. Indeed he was not the only one who was so; for when Captain Forbes, my Deputy at Meerpoor, afterwards wrote to Captain Malet, the Resident, upon the subject, he too also replied, I remember, saying that he had made every inquiry but was unable to find that any such bund was in existence.

14. I had myself, indeed, always imagined that the bund lay in Meer Ali Moorad's territory, and had attributed this misleading to his people; and, supposing that it was so, a very simple means might have been employed to bring any negociation on the subject to a satisfactory conclusion, for his Highness could, of course, have made no objection to authorising us to break down, if

\* Minor canals.

we could find it, a bund which, to the best of his knowledge and belief, had no existence; that would have been, to say the least of it, a very simple and harmless way of gratifying an ally. Yet this much in the shape of concession, supposing that the demolition of the obstruction was not on our part a *right*, is all that we should have required; but that it would have been a right on our part, and a most undoubted one, is clear. The Khyrpoor State could have no more title to bund up a stream like the Narra than would have the Bhawalpoor State to bund up the Indus, supposing it able to do so, or to do what it might be able to do, erect works on it destructive of its capacities for navigation.

15. The Jaghire, however, of Futteh Mahomed Ghoree, in which the bund lies, as well as the land on the other side of it, now forms part, I am told, of the Purgunnah of Roree, and is in our possession. I am almost afraid that my informant is mistaken in this, but, if not, nothing, I imagine, can be required but an order from yourself to the Collector of Shikarpoor to have the bund removed. As to the actual increase to the revenue of this Collectorate that may be expected to arise from the measure, I am unable, with any certainty, to speak. Guided by Native authorities, I stated, in November 1843, that I believe it might amount to about five laks, and I have since heard that estimate given more than once by Deputy Collectors of Meerpoor, whose sources of information were wholly independent of mine. But, on the other hand, there are many who do not reckon it at more, even in good years, than about twenty thousand, and there is no accurate information to be got from the *Duffers* on the subject. For, in the first place, they only give the rents of a part of the land, and in the next they give that very inexactly. In fact the revenue on the Narra was never properly collected or attempted to be so. The *Buttai* system was never in force there; the assessment was always made by estimate; and as the *Meers'* chief object was rather to preserve men with so many opportunities of being turbulent in their obedience than to extract revenue from them, they dealt lightly with the races living there and took no very strict account from them of the *Sirkar's* dues. But if it is difficult to tell the exact amount of increase that might arise to the revenue from the sweeping away the Narra Bund, there can be none as to the political and social advantages that this measure would confer. It would remove a standing violation of all natural justice, for what can be more inequitable than that the supply of water which God sends the people should be thus cut off? it would do much towards restoring to prosperity the now almost ruined towns and villages along the Narra's banks; and the lakes refilled would afford a comfortable means of subsistence to thousands, where nothing now but the *Peloo* and *Tamarisk* grow. These are advantages which, in the eye of a civilized Government, will always outweigh those of mere money, however necessary to be looked to, as the world is constituted, these may be.

I have the honour to be, &c.

31st October 1850.

(Signed) A. B. RATHBORNE, Collector.

No. 1915 of 1850.

TERRITORIAL DEPARTMENT, REVENUE.

From the COMMISSIONER IN SIND,

To Lieut. Colonel W. SCOTT, Superintending Engineer, Sind.

SIR,—I have the honour to request you will favour me with your opinion on the subject of the accompanying copy of a report, No. 862, dated the 31st ultimo, from the Collector of Hyderabad, relative to the re-opening of the Eastern Narra.

2. It seems hardly probable that Captain Baker should have been mistaken in opinions which purport to have been founded on detailed surveys; but Captain Rathborne appears to rely with much confidence on the accuracy of his information.

3. To facilitate your consideration of the question, I forward, in original, Captain Baker's report, and the rough plan derived from Native information which accompanied Captain Rathborne's letter, and which I request may be returned with your reply. You can have access to the plans illustrative of Captain Baker's report, which are now in my office, on your return to Kurrachee.

I have the honour to be, &c.

(Signed) R. K. PRINGLE,

Commissioner in Sind.

20th November 1850.

No. 1430.

TERRITORIAL DEPARTMENT, REVENUE.

From Lieut. Colonel W. SCOTT,

Superintending Engineer, Sind,

To R. K. PRINGLE, Esq.,

Commissioner in Sind.

SIR,—I have the honour to acknowledge the receipt of your letter No. 1915, of 20th instant, transmitting copy of Captain Rathborne's letter No. 862, dated 31st October, together with a Native sketch of the course of the Narra, copy of a sketch of the same with the names of the villages in English, and copies of reports on canals west of the Indus and in the upper portion of the Eastern Narra by Captain Baker. The latter four documents I herewith return.

2. It would appear from Captain Baker's report, para. 5, that the construction of the Arore Bund, or at least of some bund affecting the Narra, was anterior to 1826. I fear, therefore, that the bed through which Captain Rathborne supposed the Narra to have been fed has altered materially, and that the simple removal of the obstruction (if such exist) will not be sufficient.

3. Speaking from recollection, I think that Captain Baker's line of survey led him into the Narra east of Arore, and that other lines of survey were carried generally parallel to the line of the Indus, and that the bed of the Narra was not examined between the point at which Lieutenant Blagrove crossed it to the north, and the point where Captain Baker fell into it: some bund or bunds may therefore exist.

4. I should think that there could be little difficulty in ascertaining the facts of the case by sending an officer to visit the places which Captain Rathborne points out, and the general course of the Narra, to which he will probably find numerous feeders; the main bed being probably that depression of country noted as coming from Rooper in the 3rd paragraph of Captain Baker's report.

5. Captain Baker's survey was sufficient for the purposes which he had in view (the permanent supply of water), and I would request attention to his 11th, 12th, and 13th paragraphs.

6. It does not appear to me possible to settle the question unless some person be sent to inspect the place. I have more than once been applied to to cut bunds which had really at the time no effect on the irrigation.

7. I doubt the possibility of damming the Narra until it had been so reduced by other circumstances as to have become of little value.

I have, &c.

(Signed) W. SCOTT, Lieut. Colonel,  
Superintending Engineer, Sind.

22nd November 1850.

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No. 1937 OF 1850.

TERRITORIAL DEPARTMENT, REVENUE.

From the COMMISSIONER IN SIND,

To the ACTING COLLECTOR OF SHIKARPOOR.

SIR,—In transmitting the accompanying copy of a correspondence as per margin, together with the reports of Captain Baker and Captain Rathborne in original, on the subject of the re-opening the Narra Canal, I have the honour to request that you will take measures for verifying the information obtained by Captain Rathborne, and favour me with your opinion and report on the question generally, returning the original documents with your reply.

To the Superintending Engineer, No. 1915, dated 20th instant.

From ditto ditto, dated 22nd ditto, No. 1430.

I have, &c.

(Signed) R. K. PRINGLE,  
Commissioner in Sind.

25th November 1850.



No. 85 OF 1851.

## REVENUE DEPARTMENT.

From the ACTING COLLECTOR, UPPER SIND,

To the COMMISSIONER IN SIND.

SIR,—I have the honour to acknowledge the receipt of your letter No. 1937, of the 25th November last, with enclosures from the Collector of Hyderabad, on the subject of the supposed Narra Bund.

2. On a late occasion I proceeded to the spot pointed out in the 7th paragraph of Captain Rathborne's letter, and found there the bund noticed by that officer, but not in the position nor of the magnitude which would appear to have been represented to him by his informant.

3. From information which I was enabled to collect from parties who might be presumed well acquainted with the localities, it appears that the Narra has now no separate head in the banks of the Indus, and that, within the memory of man, the supplies of water which its bed used to receive in former years, were obtained by the direct overflow of the river, or what the natives in this part of Sind call the "Leht."

4. These overflows, or-lehts, which followed the periodical rise of the river, were two in number, one leaving the main bed of the Indus in the vicinity of Ahmedpoor, and the other further to the south and near the Gotekee district of this Collectorate. The former of the two, however, afforded the main supply of water to the ravines from which the Narra derived its source, and, from the mass of water which it threw off, was termed *par excellence* the "Khoonun Leht," the other only contributing to any extent in seasons of an extraordinary overflow. The floods formed by these lehts spread for miles over the country in every direction, and taking naturally to the lower tracts, worked out channels for themselves, which again communicated with each other by lakes, or colabs, until they all converged upon nearly the same point, and, pouring their contents into one channel of egress, formed the stream which is now known as the Narra. Numerous embankments are to be seen thrown across these channels or ravines to retain the waters for agricultural purposes, and, as such, are noticed in the 4th paragraph of Captain Baker's report.

5. The tract of country in which most of the abovementioned channels converge, lies between the villages of Fukeerabad and Trigadee, and it is here that the Narra first begins to have a defined bed; this, at the part I examined, was between three and four hundred feet broad, and was perfectly dry, with the exception of pools here and there, which, I was informed, derived their supply from under-ground sources, and one of which was pointed out to me said to be upwards of sixty feet in depth. To the north of Fukeerabad, which is about six miles north-east from the village of Birha, where the bund alluded to by Captain Rathborne is to be found, the Narra, I was told, has no distinct channel

of its own. Trigadee is also about six miles from Birha to the south-east, and there the bed of the stream is unmistakeable; at its nearest point it is fully five miles distant from the bund which Captain Rathborne supposes to be the key of its supply.

6. This bund, lying close to the village of Birha, is one of those adverted to in the 4th paragraph of this letter, and the ravine which it confines, one of the channels therein noticed. The bund is formed of earth and brushwood rammed closely together, 600 feet in length, 38 feet broad at top, and with a height of 22 feet; the highest water-mark in its rear being 15 feet, the breadth of the ravine, a short way below the bund, about 200 feet. I could discover no bund one koss long and with a breadth of forty guz, as described by the Collector of Hyderabad, nor, from the inquiries which I made, do I think that such exists. The ravine in rear of the bund was, at the time I visited it, perfectly dry, nor is it said to retain any water after the subsidence of the inundation: it communicates with the main bed of the Narra near the village of Trigadee, and there is no doubt that, if removed, the water which it must at one season of the year retain would flow into that stream; but whether the supply which would thereby be secured to the latter would be of any use to the Hyderabad districts, is, I should say, problematical.

7. In the first place the waters, a portion of which the bund confines, are those of the Gotekee or minor leht, and it in no way interferes with the flow of the Ahmedpoor or principal one, which used to find its ingress into the Narra chiefly by the Raine Channel alluded to in the 7th paragraph of Captain Baker's report; and secondly, the chances are, that as the limited stream to which the removal of the bund would afford a passage, only waters now about 12,000 rupees' worth of land, and that at the spot where it is first impeded, it would scarcely irrigate so much at fifty or a hundred koss further down and after a passage through a sandy country, where much of its body would necessarily be lost from the light and retentive nature of the soil.

8. There would, however, have been no objections towards removing the bund, and to our testing the results of the measure during one season, had not the villages in its vicinity been lately leased out for a term of four years, upon the faith of its continuance, and any arrangements which would deprive them of the accustomed supply of water would necessarily involve the discontinuance of the leases, and, supposing the lessees ready to throw up these, be the occasion of considerable loss to Government. The revenue of these villages is about Rs. 7,000 per annum; the residue of the land within the influence of the bund belonging to his Highness Meer Ali Moorad Khan.

9. Before, therefore, causing the removal of the bund, we must satisfy ourselves that a greater and equally direct advantage from that measure will accrue to Government in the Hyderabad Collectorate, and this, as I have stated, is very far from certain, because the work merely impedes a small portion of the Narra's supply, and because that supply I believe to have been received chiefly

from the Ahmedpoor or Khoonun Leht, which has of late years been interrupted by causes perfectly disconnected with the bund or anything relating to it.

10. These causes, I am credibly informed, lie in the construction along the bank of the Indus, within Bhawul Khan's territory, of extensive embankments, whereby the Khoonun Leht is prevented from encroaching into the adjacent tracts, which, from its violent action, used formerly to be converted into unproductive swamps, or, if the encroachment has not been entirely prevented, the supply has been regulated to meet the wants of the land for cultivation: and although, as far as our Government in Sind is concerned, the measure on the part of Bhawul Khan is to be regretted, it would be scarcely legitimate for us to interdict him from preventing his country suffering from excessive inundations, the more especially as Captain Baker, in the 13th and following paragraphs of his report, has pointed out to us the manner in which a remedy can be applied within our own reach; and as the advantage to the Hyderabad Collectorate from a supply of water in the Narra are shown to be so immense, his suggestions would appear well worthy the attentive consideration of the local authorities and of Government.

11. The enclosures received with your letter are herewith returned.

I have the honour to be, &c.

(Signed) G. INVERARITY,  
Acting Collector, Upper Sind.

*Camp Khyrpoor, 6th February 1851.*

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No. 420 of 1851.

REVENUE DEPARTMENT.

From H. B. E. FRERE, Esq.,  
Commissioner in Sind,

To the Right Honorable LORD VISCOUNT FALKLAND,  
Governor and President in Council, Bombay.

MY LORD,—I have the honour to submit, for the consideration of your

Captain Baker's report, dated October 1844.  
Letter from Collector of Hyderabad, No. 862,  
dated 31st October 1850.

Ditto to Colonel Scott, Superintending Engineer, No. 1915, dated 20th November 1850.

Ditto from ditto, No. 1430, dated 22nd ditto.

Ditto to Acting Collector of Shikarpoor, No. 1937, dated 25th November 1850.

Ditto from ditto, No. 85, dated 6th Feb. 1851.

Lordship in Council, copies, as per margin, of documents relating to the possibility of restoring water to the ancient channel of the Indus called the Eastern Narra, and of thereby adding greatly to the revenues of the Hyderabad Collectorate.

2. Your Lordship in Council will observe—

1st. That Captain Baker, with whose high merits as an Engineer officer your Lordship is well acquainted, considered it probable that the obstruction of the Narra was not any single artificial work.

2nd. That he did not ascertain conclusively, and in a manner to remove all doubt on the subject, whether or not he was correct in this supposition.

3rd. He sketched out a plan for opening, at no great cost, a new mouth, which would give the required supply, under the restrictions necessary, for the security of other important objects.

4th. That Captain Baker's project lay over during the troubled times which succeeded 1844, the year in which it was sent in.

5th. That Captain Rathborne, Collector of Hyderabad, has since obtained, what he considers strong evidence, to show that the obstruction is an artificial work of recent erection, the removal of which would at once restore the ancient supply.

6th. That Mr. Inverarity has visited the spot indicated by Captain Rathborne, and sees reason to agree rather with Captain Baker, that the artificial obstruction there existing is not the sole, even if it be the principal cause, of the deficiency of supply, and that this view is confirmed by the opinion of Colonel Scott.

Finally. That while all are agreed as to the great benefits which would follow the restoration to the Eastern Narra of an abundant supply of water, it is still doubtful whether the obstruction to such a supply is an artificial bund, or a change in the course of the main Indus, and, if the latter, what would be the cost of the measures proposed by Captain Baker for providing a supply.

3. It seems to me, that the magnitude of the benefits promised by a restoration of a full supply of water to the Narra, is such as to justify the employment of an officer on this special duty, and I would, therefore, recommend that a duly qualified Engineer officer be deputed for the purpose.

4. As the interests of the Rao of Cutch are involved, I would recommend that the officer in question should be directed to examine and most carefully level the whole country from Cutch northwards *viâ* Oomerkote, and the bed of the Narra up to the Indus north of Roree, taking occasional cross levels, east to the rising lands of the Desert and west to the Indus, the northern portion of the Narra and all its tributary channels being minutely examined. He would then be able to decide what would be the effect of cutting the bund or bunds which may exist there; whether their influence be as great as supposed by Captain Rathborne, or as small as believed by Colonel Scott and Mr. Inverarity; whether there be any means of getting the required supply, other than that sketched out by Captain Baker, and, if not, he will be in a condition to estimate exactly the cost of carrying out Captain Baker's plan.

5. It is needless to observe that for such a duty it is useless to employ

any but an officer of first-rate scientific acquirements. The duty would occupy him the whole of the short working season in that part of the province, viz. from the end of the fever season in November till the commencement of the extreme heat in April; but it would be very desirable that he should start with full experience of the nature and extent of the stream of the Indus at its height, which is best seen between April and October.

I have the honour to be, &c.

(Signed) H. B. E. FRERE,

Commissioner in Sind.

*On the Indus, 18th March 1851.*

No. 8253 of 1851.

TERRITORIAL DEPARTMENT, REVENUE.

Captain Crawford is requested to favour Government with his report and opinion on the subject of these papers.

By order,

(Signed) H. E. GOLDSMID,

Secretary to Government.

*Bombay Castle, 29th March 1851.*

No. 14 of 1851.

TERRITORIAL DEPARTMENT, REVENUE.

To H. E. GOLDSMID, Esq.,

Secretary to Government, Bombay.

SIR,—I have the honour to acknowledge the receipt of your endorsement of the 29th ultimo, on a letter, No. 420, from the Commissioner in Sind to the Right Honorable the Governor in Council, on the subject of the Eastern Narra.

2. I cannot speak on this subject from personal knowledge, having never visited the portion of Sind referred to. A perusal of the papers and inspection of Captain Baker's map, would, I should imagine, fully satisfy any person that the Collector of Hyderabad has been misled by Native reports, which are most probably altogether traditional, and refer to a very long by-gone state of affairs.

3. Both Captain Baker's report and the one of a much later date by the Collector of Shikarpoor, agree in the fact of there being now no defined channel to the Narra above the latitude of Roree, and there can be little doubt that cutting the bund alluded to (one it appears of much less consequence than the Native report makes out) would probably cause much local loss, without effecting any counterbalancing general advantage.

4. Should Government determine upon taking any steps towards investigating the advantages and cost of restoring a stream of water to the bed of the Narra, the preliminary surveys, when put in hand, should be so provided for as to admit of their being perfected in one season; and I would, therefore, beg to bring particularly to your notice, that the quantity of work detailed in the 4th paragraph of the Commissioner's letter, is far more than any person could manage in one working season.

5. I should estimate that, to prepare carefully the levels required, would give full employment to an Engineer officer, and two Assistants, either officers or men, but who must be fully equal to the work, and capable of being trusted to carry it on alone, without any immediate superintendence.

6. The Principal's duty would be to select a spot and fix a bench-mark somewhere in the bed of the Narra, where it begins to take the form of a single uninterrupted channel. Thence one Assistant should proceed to level down the course of the river southwards, taking occasional cross sections; the other would proceed to examine carefully any large branches coming from the northward or westward, tracing them, if possible, to the point of their issue from the river, and ascertaining what, if any, obstructions do exist.

7. The Principal himself would revise the levels from Roree to the bed of the Narra, and examine the ground, by boring, to ascertain its nature, with reference to the formation of the new head as proposed by Captain Baker.

8. With less means at command than that abovementioned, I do not think that the work could be satisfactorily concluded in a single season.

I have the honour to be, &c.

(Signed) J. H. G. CRAWFORD, Captain,

Late Actg. Supt. of Canals in Sind.

*Bombay, 7th April 1851.*

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No. 5334 of 1851.

TERRITORIAL DEPARTMENT, REVENUE.

To the MILITARY BOARD.

GENTLEMEN,—I have been directed to annex copy of the papers noted in the margin, and to request that you will favour

Extract (para. 4) of letter from the Commissioner in Sind, No. 420, dated 18th March 1851.

Letter from Captain Crawford, No. 14, dated the 7th ultimo.

Government with your opinion as to the arrangements which can be made for carrying into effect, at the very commencement of the next working season, the suggestion made by Captain Crawford in the 4th paragraph of his letter, dated 7th ultimo, No. 14.

I have the honour to be, &c.

(Signed) H. E. GOLDSMID,

Secretary to Government.

*Bombay Castle, 13th May 1851.*

No. 4693 OF 1851.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To the Right Honorable LORD VISCOUNT FALKLAND, G.C.H.,  
Governor and President in Council.

MY LORD,—We have the honour to acknowledge the receipt of Mr. Secretary Goldsmid's letter No. 5334, of the 13th ultimo, and, in reply, would represent to your Lordship in Council, that the Department does not afford the means of effecting the survey of the Narra as suggested by Captain Crawford, and, on our referring to the Chief Engineer, to learn whether any other Engineer officer can be made available, that officer states that he does not see any probability of officers being available for the survey.

We have the honour to be, &c.

(Signed) C. WADDINGTON, Lieut. Colonel,  
Chief Engineer.

„ J. SWANSON, Major.

*Bombay, Military Board Office, 9th June 1851.*

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No. 6499 OF 1851.

TERRITORIAL DEPARTMENT, REVENUE.

To H. B. E. FRERE, Esq.,  
Commissioner in Sind.

SIR,—With reference to Mr. Secretary Goldsmid's letter No. 5335, dated the 13th ultimo, I have been directed by the Right Honorable the Governor in Council to transmit herewith copy of one from the Military Board, No. 4693, dated the 9th instant, and to request that you will state whether there is any officer in Sind who could be rendered available for the duty therein mentioned.

I have the honour to be, &c.

(Signed) A. MALET,  
Chief Secretary to Government.

*Bombay Castle, 17th June 1851.*

No. 1241 of 1851.

TERRITORIAL DEPARTMENT, REVENUE.

From the COMMISSIONER IN SIND,

To Lieut. Colonel SCOTT, Superintending Engineer, Sind.

SIR,—In transmitting the accompanying copy of correspondence, as noted in

To Government, No. 420,  
dated 18th March 1851.From ditto, No. 5535, dated  
13th May, with enclosure.From ditto, No. 6499, dated  
17th June 1851.

the margin, on the subject of re-opening the Eastern Narra, I have the honour to request that you will do me the favour to state, whether you know of any officer in Sind who could be rendered available for the survey duty therein mentioned.

I have, &amp;c.

(Signed) H. B. E. FRERE,

Commissioner.

*Kurrachee, 30th June 1851.*

No. 939 of 1851.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To H. B. E. FRERE, Esq.,

Commissioner in Sind.

SIR,—With reference to your letter of the 28th ultimo, No. 1241, I have the honour to state, that it would require the undivided attention of an officer with a proper establishment to make a satisfactory examination of the sources, &c. of the Narra instrumentally. I therefore regret that I cannot recommend the employment of any of the Executive officers on the work, and I do not know any other officer in Sind competent to the duty.

2. I was unable, when Superintendent of Canals, to pursue the investigation, as it is one requiring an officer's whole attention, both from the nature and locality of his operations; I think, however, Lieutenant Fife could set the question brought forward by Captain Rathborne at rest, as he will be able to see, during this inundation, whether any single obstacle, or even whether several artificial obstacles, exist, and thus the field of future operations might be narrowed without danger.

3. Captain Baker could not find the bund alluded to. It may be that the people will not show it, being conscious that if it is cut they will lose much Rubbee land; on the other hand, Captain Rathborne's informants may very possibly have a strong bias. If this be the case, it is not a solitary instance; Native gentlemen are constantly complaining of such bunds, quite as much with a view to reduce their neighbours as to benefit themselves. I think it therefore most essential that at least one of Captain Rathborne's informants should accompany Lieutenant Fife and point out what he means.



4. According to my recollection and Captain Baker's survey, there is no regular ancient channel in which to look for this bund; though there is plenty of lowland, and many Dunds, one or all of which may finally discharge into the Narra, if not hindered by artificial means.

5. If you think it desirable to proceed in this way, I will send particular instructions to Lieutenant Fife.

I have the honour to be, &c.

(Signed) W. SCOTT, Lieutenant Colonel,

*Kurrachee, 4th July 1851.*

Superintending Engineer, Sind.

No. 1318 of 1851.

TERRITORIAL DEPARTMENT, REVENUE.

From the COMMISSIONER IN SIND,

To the ACTING COLLECTOR OF HYDERABAD.

SIR,—In forwarding the accompanying copy of correspondence on the subject of the Eastern Narra, I have the honour to request that you will be good enough to inform me, whether you know who was Captain Rathborne's informant as to the existence of the bund alluded to, and whether he could be prevailed on to accompany Lieutenant Fife to the spot, as proposed by the Superintending Engineer.

I have the honour to be, &c.

(Signed) H. B. E. FRERE,

*Kurrachee, 9th July 1851.*

Commissioner in Sind.

No. 497.

REVENUE DEPARTMENT.

From the ACTING COLLECTOR OF HYDERABAD,

To the COMMISSIONER IN SIND.

SIR,—I beg to acknowledge the receipt of your letter, No. 1318 of 1851, Territorial Department, Revenue, on the subject of the Eastern Narra, and to inform you that Captain Rathborne's informant, as to the existence of the bund alluded to, was a man named Wishen Sing, formerly Kardar of the Purgunnah of Shahwah Lohanna, now out of employment, and now residing at Shahdadpoor, and one of the lessces of the Purgunnah of Shahwah.

2. Should I receive your orders, I will direct this man to join Lieutenant Fife as soon as possible at Sukkur or Roree; at the same time, I would recommend that his expenses be paid him, and that a certain gratuity, if his information be found to be correct, be given him.

I have the honour to be, &c.

(Signed) H. FENNING, Captain,

*Hyderabad Collector's Office, 14th July 1851.*

Acting Collector.

No. 1394 of 1851.

REVENUE DEPARTMENT.

From the COMMISSIONER IN SIND,

To the SUPERINTENDING ENGINEER, SIND.

SIR,—Adverting to previous correspondence, I have the honour to forward copy of a letter from the Acting Collector of Hyderabad, No. 497, dated the 14th instant, on the subject of the Narra Bund, and, with reference thereto, to inform you, that I will order the person alluded to by Captain Fenning to proceed at once to Sukkur, if you think that Lieutenant Fife could make any examination which would be conclusive on all the points at issue, without incurring serious risk at this season of the year.

I have the honour to be, &amp;c.

(Signed) H. B. E. FRERE,

Commissioner in Sind.

*Kurrachee, 18th July 1851.*

No. 990 of 1851.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To H. B. E. FRERE, Esq.,

Commissioner in Sind.

SIR,—With reference to your letter No. 1394, of the 18th current, it appears to me that Lieutenant Fife could, by personal inspection, decide the question as to the correctness of Captain Rathborne's information; that is, he could say, by a mere inspection, whether any one or more artificial obstacles have been opposed to the natural course of the Narra.

2. I think it would be desirable to furnish him with a copy of Captain Baker's survey and report, which is, I believe, in your office, and also of Captain Rathborne's letter.

3. There will, I apprehend, be some risk and considerable exertion in making an examination while the water is in the country, but less danger of fever, than if it should be attempted at a later period, when also it would be more difficult to arrive at a true conclusion.

4. As much will depend on the state of the country and of Lieutenant Fife's own health, it will probably be better to allow him to communicate with Captain Fenning.

5. I will make a tracing of the plan if you will kindly allow it to be sent to me. There is great danger of injury in sending plans in cases at this time of the year.

I have the honour to be, &amp;c.

(Signed) W. SCOTT, Lieut. Colonel,

Superintending Engineer, Sind.

*Kurrachee, 19th July 1851.*

No. 1438 of 1851.

REVENUE DEPARTMENT.

From the COMMISSIONER IN SIND,

To Lieut. Colonel SCOTT, Superintending Engineer, Sind.

SIR,—I have the honour to acknowledge the receipt of your letter of the 19th instant, No. 990, and, in reply, to forward, as therein requested, the papers noted in the margin, in reference to the Narra Bund, which you will be good enough to send to Lieutenant Fife, who should obtain from the Collector of Shikarpoor, and other authorities in Upper Sind, all the aid they can afford and which he thinks likely to be useful in facilitating his labours.

2. He should also be guided as to the time of making his observations by the state of the weather, and other local circumstances, so as to incur as little risk as possible; and to save time, he should communicate direct with the Collector of Hyderabad.

3. Copy of my letter of this date, No. 1439, to the Collector of Shikarpoor, on the above subject, is herewith enclosed.

I have, &amp;c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind.

*Kurrachee, 24th July 1851.*

No. 1440 of 1851.

REVENUE DEPARTMENT.

From the COMMISSIONER IN SIND,

To the ACTING COLLECTOR OF HYDERABAD.

SIR,—With reference to previous correspondence relative to the Narra Bund, I have the honour to transmit copy of the papers as per margin, and to request that you will be good enough to co-operate, as far as you can, in the present examination, especially by despatching Wishen Sing to join Lieutenant Fife.

2. This individual should be guaranteed his expenses, as well as a promise of any reward you may think requisite, to secure his faithful services; the reward to be contingent on his showing such a bund as he described to Captain Rathborne, the removal of which would restore water to the Narra.

\* I have, &amp;c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind.

*Kurrachee, 24th July 1851.*

No. 1447 of 1851.

## REVENUE DEPARTMENT.

From the COMMISSIONER IN SIND,  
To the Right Honorable VISCOUNT FALKLAND,  
Governor and President in Council, Bombay.

MY LORD,—With reference to Mr. Chief Secretary Malet's letter No. 6499,

To Superintending Engineer, No. 1241, dated 30th June.

From ditto, No. 939, dated 4th July.

To the Collector of Hyderabad, No. 1318, dated 9th July.

From ditto, No. 497, dated 14th July.

To Superintending Engineer, No. 1394, dated 18th July.

From ditto, No. 990, dated 19th July.

To ditto, No. 1438, dated 24th July.

To Collector of Hyderabad, No. 1440, dated 24th July.

dated 17th ultimo, I have the honour to transmit copy of a correspondence that has passed consequent thereon, as per margin, on the subject of the survey of the Eastern Narra, the tenour of which will, I trust, be approved by Government.

2. Your Lordship in Council will observe from these papers, that Lieutenant Fife's examination can

only set at rest the question as to whether it is any single obstruction which prevents the flow of water into the Narra, and cannot, therefore, supersede the necessity for other surveys, unless it should prove that Colonel Scott, Captain Baker, and Mr. Inverarity have all been mistaken.

3. Should it prove that they are right, and that Captain Rathborne was misinformed, Lieutenant Fife's examination will do little towards carrying out Captain Baker's plan. Because, in the event of the obstruction proving to be as that officer seems to have believed, not any one work but a gradual filling up of many sources of supply, and the want of a single sufficient feeder such as Captain Baker proposed to cut from Roree, the survey for the purpose of determining the line of such feeder, and its probable expense, will have to be made in the cold season, when the water is off the ground.

4. For such surveys, Government will observe, from Colonel Scott's report, there is no officer available in Sind.

5. But, adverting to the immense prospective revenue and other advantages at stake, I would earnestly urge, on the favourable consideration of your Lordship in Council, the propriety of making some sacrifice to secure the services of a competent officer, before the opening of the next brief season, for travelling in the Eastern Desert. It is not for me to venture to point out how this may be best done, but I am sure your Lordship will excuse my suggesting that some temporary provision might be made for the duties of some competent Executive Engineer, who might thus be enabled to devote the season to a work of such importance.

I have the honour to be, &c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind.

*Kurrachee, 25th July 1851.*

No. 8800 of 1851.

TERRITORIAL DEPARTMENT, REVENUE.

To the MILITARY BOARD.

GENTLEMEN,—I have been directed by the Right Honorable the Governor in Council to acknowledge the receipt of your letter No. 4693, dated the 9th June last, relative to the survey of the Eastern Narra, and, in transmitting herewith copy of a communication on the subject from the Commissioner in Sind, No. 1447, dated the 25th July last, and of its accompaniments, to request that you will be so good immediately to consider and report the best arrangement you can propose for detaching to Sind a competent and fully qualified officer, or two if absolutely necessary, to perform the duty indicated by Mr. Frere; the duties of the officers so detached being, in the mean time, performed by an Infantry officer, or in some other manner.

2. You will understand that the Government attach sufficient importance to the work in question, to render it desirable that no trivial obstacle should be allowed to interfere with its efficient performance.

I have the honour to be, &c.

(Signed) H. E. GOLDSMID,

*Bombay Castle, 4th September 1851.*

Secretary to Government.

No. 278 OF 1851.

From Lieut. Colonel C. WADDINGTON, C.B., Chief Engineer,

To Lieutenant W. F. MARRIOTT, Secretary to the Military Board.

SIR,—I have the honour to acknowledge the receipt of your memorandum No. 7429, of the 11th instant, with the accompanying correspondence, regarding the Narra River, and directing me to report on the same.

2. The instructions of Government, contained in Mr. Secretary Goldsmid's letter No. 8800, are, that the Military Board should "immediately consider and report the best arrangement they can propose for detaching to Sind a competent and fully qualified scientific officer, or two if absolutely necessary, to perform the duties indicated by Mr. Frere," and they are further informed "that no trivial obstacle should be allowed to interfere with the efficient performance of the work in question."

3. The work indicated in the Commissioner's letter No. 1447, appears to be "a survey for the purpose of determining the line of a feeder (to the Narra) such as Captain Baker proposed to cut from Roree, and its probable expense."

4. In making a preliminary examination and rough survey of the country near the head of the Narra, Captain Baker and his whole establishment (four Commissioned officers and three Sergeants) were occupied for some months

The detailed survey, therefore, necessary to determine exactly, and afterwards to delineate the ground through which a cut should be taken from near Roree to the Narra river, with the necessary levellings, and a careful estimate of expense, will not be a light undertaking, and I should not recommend that a smaller number than three officers, with a fitting establishment, be employed on it, because the time for making the necessary observations is limited, and, if undertaken at all, the work should be completed in one season.

5. Lieutenant Fife, the Executive Engineer Upper Sind, is the officer most readily available for conducting this survey, and is, I have reason to think, qualified to undertake that duty. There are no Engineer officers available as Assistants, unless his Excellency the Commander in Chief will consent to their being detached from the Sappers and Miners. I would in that case beg to recommend for the duty Lieutenants Stainforth and Goddard, both of whom have been with the head quarters of the Sappers considerably more than a year. It is probable also that some of the Non-Commissioned officers have assisted those officers in surveying the city of Poona, and might be useful in the projected survey of Sind.

I have the honour to be, &c.

(Signed) C. WADDINGTON, Lieut. Colonel,  
Chief Engineer.

*Bombay, Chief Engineer's Office, 15th September 1851.*

*Minute by the Honorable Board.*

The suggestions herein made may be acted on, and instructions given in the proper Department that they may be at once carried into effect.

(Signed) FALKLAND.  
" D. A. BLANE.  
" A. BELL.

30th September 1851.

*Extract (para. 1) of a letter from the Military Board, No. 7830, dated  
25th September 1851.*

With reference to Mr. Secretary Goldsmid's letter No. 8800, of the 4th instant, with accompaniments, regarding the proposed survey of the Narra river, we have the honour to submit, for the information of your Lordship in Council, a communication, No. 278, of the 15th instant, from the Chief Engineer, on the subject of the arrangements requisite for carrying out the survey indicated.

No. 413 of 1851.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To the SUPERINTENDING ENGINEER, SIND.

SIR,—I have the honour to acknowledge the receipt of your letter No. 1074, of the 5th August, and accompaniments, regarding the Eastern Narra.

2. The Officiating Collector, Hyderabad, informed me, in a letter dated 28th July, that he had directed a man named Wishen Sing to proceed at once to Shikarpoor to point out the bund said to stop the Narra. This person did not reach me till the beginning of September, and until the floods feeding the Narra had ceased.

3. Fortunately, however, the measures I took beforehand to ascertain whether the bunds had actually the effect attributed, proved so effectual as to render the delay of no consequence.

4. The Narra is fed by two floods, one of which comes from near Subzulcote, the other from the low ground between Alleewan and Kashimpoor, a few miles above Roree. The two floods meet above the bunds at Birha, Syed Ali Acbar, and Fukeerabad, and then flow across the country into the Narra, filling the artificial bunds on their way.

5. Now it is perfectly plain that had these bunds really the effect ascribed, the floods being prevented from escaping south by the Arore range of hills, would return to the *Indus above Roree*. But this is not the case, they flow over the country between and beyond the bunds into the Narra. From the Arore hills to the village of Fukeerabad, a distance of eight miles, the country is flooded, the whole of the water flowing steadily to the south-east.

6. Thus, then, the question about these bunds is set at rest.

7. What really caused the stoppage of the Narra, how the report that the Arore masonry bund was the cause arose, and with what view that bund was constructed, I shall in a day or two endeavour to explain.

I have the honour to be, &c.

(Signed) J. G. FIFE, Lieutenant,

Executive Engineer, Upper Sind.

*Sukkur, 2nd October 1851.*

No. 1486 of 1851.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To H. B. E. FRERE, Esq.,

Commissioner in Sind, Kurrachee.

SIR,—I have the honour to transmit copy of a report, No. 413, dated the 2nd instant, by Lieutenant Fife, on the Eastern Narra. I agree with Lieutenant Fife, and can add nothing to his report.

2. I think it is better to communicate this report at once, than to wait for the further information which Lieutenant Fife promises.

I have the honour to be, &c.

(Signed) W. SCOTT, Lieut. Colonel,  
Superintending Engineer in Sind.

*Kurrachee, 11th October 1851.*

No. 1493 of 1851.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To H. B. E. FRERE, Esq.,

Commissioner in Sind, Kurrachee.

SIR,—As it is not certain when I shall receive Lieutenant Fife's promised additional report on the Eastern Narra, and as I shall probably be pressed for time when it arrives, I do myself the honour to submit my views on the subject at once, although it is not necessary that the instructions should be issued to Lieutenant Fife until my successor and Captain Tremenhcere may arrive.

2. It seems now quite certain that there is no decided single source of supply, the obstruction of which has prevented the Narra running as in former years.

3. It seems also clear that to cut a new head for the Narra would tend to destroy the inundated land, some portion of which lies in our own territory, and some in that of our ally his Highness Meer Ali Moorad. We certainly could avoid injuring him, but only by embanking the canal through all his low lands, but this would be precarious, looking to the nature of the soil, and certainly an expensive operation; and further, the bed of the Narra is so large and so sandy, that it would require a prodigious quantity of water to supply it.

4. If we afforded such a supply by a cut into the river, I fear very much that we might divert a larger quantity of water than could be spared, or that we might even cause the river to change its course. At present the water is mere overflow, and runs so gently over the surface as to cause no danger, but let a body of water, 10 or 12 feet deep, pass through the same country, even if the ground was hard below (which it is not—it is merely hour-glass sand), and I should certainly expect the cut to increase far beyond our power of control.

5. There are very few places on the banks of the Indus where we could construct a proper canal head, but luckily just below Roree we could do so with a moral certainty that we should always have a supply of water, and that we need not take more than we choose.

6. I do not very clearly understand what Captain Baker's intentions were,



but I much doubt whether he ever proposed to allow his canal to enter the *bed* of the Narra : I know he intended it to be perennial.

7. Nothing is considered a canal in Italy which does not discharge the water without manual labour; and, if instead of running down in the bed of the Narra and probably losing all the water in the sand, (I should say this would be certain in the cold season), we ran it along the bank parallel to the Narra, we could get a wide strip of cultivation.

8. If you agree with me in these opinions, Lieutenant Fife should be directed to conduct his survey by a series of moderate circuits, so as to get a good general idea of the levels, and he will then be probably able to form a rough estimate of the expense, sufficient to enable you to say whether the work is likely to pay.

9. The proper way of proceeding is, I think, first to ascertain whether the project is feasible. Captain Baker's surveys settle that. Next to get the general levels of the district (not of a mere line passing through it) and sketching out the probable course of the canal; to frame a rough estimate of the expense and returns; and, finally, if this estimate is sufficiently favourable, to lay down the line on the ground and to make a correct estimate.

10. If this course be not followed, I am afraid we shall find that we have taken some line which might lead to extra expense.

11. There will be some difficulty in crossing the canals in his Highness Meer Ali Moorad's country, as they cut our line, and probably they must be passed over the new canal. This adds to the necessity of a preliminary survey before the exact plan can be settled.

12. I am therefore of opinion that, commencing from below Roree, where Captain Baker proposed his head, Lieutenant Fife should be directed to work down to the south-east in circuits of about four miles sides; and as three officers are to be employed, they would thus be constantly checking each other, an object of no slight importance, because when one man makes a circuit, it is quite possible that he should make a double error.

13. An experienced leveller would not be so liable to it; but I know one instance where an error of six feet was made twice, once in excess and once in defect, in one large circuit, and the consequence was that an important project was found quite useless.

14. Three officers working independently, but constantly meeting on the same points, would check each other's work, and if an error did occur, it would only cause a loss of a few days to one of them; it is very unlikely that two men would make the same mistake, and it is scarcely possible that all three would.

I have the honour to be, &c.

(Signed) W. SCOTT, Lieut. Colonel,  
Superintending Engineer in Sind.

*Kurrachee, 11th October 1851.*

No. 2207 of 1851.

TERRITORIAL DEPARTMENT, REVENUE.

From the COMMISSIONER IN SIND,

To the Right Honorable LORD VISCOUNT FALKLAND,  
Governor and President in Council, Bombay.

MY LORD,—With reference to previous correspondence noted in the margin,

From Government, No. 6499,  
dated 17th June.To Government, No. 1447,  
dated 25th July.Indorsement from ditto,  
No. 8801, dated 4th Sept.From Superintending Engineer,  
Sind, No. 1486, dated  
11th instaut, with accompani-  
ment.From ditto, No. 1493, dated  
ditto.

I have the honour to submit, for the information of your Lordship in Council, copies of two reports from the Superintending Engineer, furnishing further particulars on the subject of the Eastern Narra. The report considerably simplifies the question, by showing that Captain Baker was right in his view, and that it now remains to be decided how his views can be carried out.

I have the honour to be, &amp;c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind.

Kurrachee, 18th October 1851.

*Memorandum of Instructions for Lieutenant Fife.*

1. The principal object Government appear to have in view in employing you on your present special duty, is to ascertain whether, by supplying the Narra with water from the Indus perennially, the revenues of the Province can be materially increased, and if so, how that supply can best be obtained.

2. Assuming that the lands on the banks of the Narra are fertile, and that the means of cultivating them exist, it is obvious that, to obtain any extensive revenue from them, the supply of water should be regular and constant.

3. In the 15th paragraph of Captain Baker's report on this subject, a copy of which has been furnished you, he mentions, as one of the conditions to be met in making a design for a canal to feed the Narra, that it must have a wide water-way at a low level, to admit an abundant supply of water during the cold weather. But the first point to be ascertained is, whether the land proposed to be irrigated is fertile; and the next, whether there are the means of cultivating it even were water supplied. You should therefore carefully seek for traces of former cultivation, inquiring minutely from the inhabitants what grain used to be grown, its quality, and yield. You should endeavour to ascertain the area of such land, and if, as I fear may prove the case, you find the population scanty, you should endeavour to learn where they have migrated, and the prospect of their return if the means of earning a livelihood be provided them.

4. If, however, the perfect restoration of the Narra, as contemplated by Captain Baker, should not prove to be a profitable undertaking, it is still very possible that by some more simple and inexpensive works, by which a larger body of the inundation would be brought into it, an adequate return for outlay might be ensured ; for, if large fishing lakes were provided, and the means afforded of irrigating their immediate banks, the want of population or fertility of soil for the more extensive undertaking, might be no objection to the more limited design.

5. The country between Fukeerabad and Tujjul has been partially surveyed and levelled, but the statistical information regarding it afforded by Captain Baker's report is very meagre. It is said that some undefined portion belongs to his Highness Ali Moorad, and that the site of the proposed feeder is intersected by his canals : their comparative level, and the boundaries of his Highness' lands, are not shown, nor noticed in any way. Lieutenant Colonel Scott, in the 10th paragraph of his letter, No. 1493, of the 11th October, states that he thinks Ali Moorad's canals should be passed over the new canal, but the ground of his opinion is not given.

6. There also seems very considerable doubt of the capability of the bed of the Narra for holding water ; it is spoken of as composed of " hour-glass sand," and from its extreme breadth in places, and the absorbent quality of its bed, it is supposed to be very unfit for conveying a supply of water to a distance economically.

7. This leads to another important subject of inquiry, viz., can the required supply of water for so long and so wasteful a channel be spared from the Indus, during the cold weather, without interfering with its navigation ?

8. On the 18th March last the Commissioner recommended that you should "level the whole country from Cutch northwards *via* Oomerkote, and the bed of the Narra up to the Indus north of Roree, taking occasional cross levels, east to the rising lands of the Desert and west to the Indus ; the northern portion of the Narra and all its tributaries being minutely examined." The object Mr. Frere had in view being, "to decide what would be the effect of cutting the bund or bunds which may exist there ; whether their influence be as great as supposed by Captain Rathborne, or as small as believed by Colonel Scott and Mr. Inverarity ; whether there be any means of getting the required supply other than those sketched out by Captain Baker, and if not, what would be the cost of carrying out Captain Baker's plan."

9. Captain Crawford, by direction of Government, reported on this proposition of the Commissioner's, and showed strong reasons for believing that Captain Rathborne had been misled with respect to the cause of the failure of the supply of water to the Narra, and expressed an opinion that it would prove positively injurious to interfere with the bunds in any way ; but with regard to the remainder of Mr. Frere's proposition, he recommended that the officer selected for superintending the inquiry should "fix a bench-mark somewhere in the bed

of the Narra where it begins to take the form of a single uninterrupted channel." That "one Assistant should proceed to level down the course of the river southwards, taking occasional cross sections; the other examining carefully any large branches coming from the northward or westward, tracing them, if possible, to the point of their issue from the river, and ascertaining what, if any, obstructions do exist." Further that you "should revise the levels from Roree to the bed of the Narra, and examine the ground, by boring, to ascertain its nature, with reference to the formation of a new head as proposed by Captain Baker."

10. Consequent on the proceedings above detailed, you were employed during the last monsoon in examining the bunds supposed to interfere with the flow of the inundation into the Narra, the results of which were detailed in your reports Nos. 413 to 415, of the 2nd and 7th of October last, and clearly prove that Captain Rathborne had been misinformed, and that were all the bunds to the north of the Narra entirely removed, the supply of water to it would still be precarious and dependent on the extent of the inundation; the true cause of the want of water being that the original channels from the Indus have silted up.

11. In the mean time Government had decided on a survey being undertaken "for the purpose of determining the line of a feeder to supply the Narra with water, and its probable expense;" but, in reporting on the project, Colonel Scott, in a letter to the Commissioner, No. 1493, of the 11th October last, recommended, for certain reasons there given, that instead of re-supplying the Narra, an entirely new canal should be dug parallel with it and near its bank; with which object, he further recommended that you should "conduct your survey by a series of moderate circuits of four miles a side, so as to get a good general idea of the levels of the country."

12. From the 16th paragraph of your letter No. 415, you appear, though on somewhat different grounds from Colonel Scott, to have adopted a nearly similar opinion, with this difference, that whereas Colonel Scott seems to have contemplated adopting a line for the new canal near the old bed of the Narra, you recommended some line between it and the Indus.

13. Colonel Scott's knowledge of the country, and experience in superintending its canals, entitle his opinions to great attention; but, as I gather from his letters that he speaks of the Narra, and the canals belonging to his Highness Ali Moorad, more from report and general knowledge than from minute and careful examination, I do not think there is any sufficient evidence before us to justify our recommending the abandonment of the Narra as a channel, and incurring the heavy outlay of cutting a new canal of such great length, until you have, by actual observation and survey, proved its unfitness for the purposes which it is reported to have answered in former times.

14. There is, however, one reason given in your letter above quoted, which, should it prove on further examination to be correct, will afford a strong argument for abandoning the Narra altogether. I understand that you expect to find that its banks are not raised like those of the Indus, the lands

on either side gradually sloping from the river, and thereby affording facilities for cutting canals ; but that the land to the west at least rises from the bed of the river towards the Indus. If this be the case (and Captain Baker's sections tend to confirm such an opinion), it is obvious that to irrigate such land will require works for raising water. Captain Baker's levels, however, refer to the upper portion of the Narra only, and it is very probable, I think, that the lands bordering on the lower part of the river will be found to have a different section.

15. I have entered thus into detail in placing before you the present state of the subject, that you may see how much information is needed, and how guarded you should be in forming opinions hastily or on insufficient data. A few facts are worth all the theory in the world to enable a correct opinion to be formed on a question like the present one ; and I hope that you will now be able, by actual measurement and examination, to afford satisfactory data on all the points that require to be cleared up, so as to enable Government to come to a decision.

16. I approve of your having proceeded to Oomerkote for reasons stated in your note of the 28th ultimo. On being joined by your Assistants, you should, in the first instance, examine the Narra southwards, as far within the limits of the Hyderabad Collectorate as it may seem to be available for an irrigating channel. A single line of levels along the bed of the river, and a few cross sections, will suffice for this portion ; but the statistical information indicated in the 3rd paragraph, and a full account of the soil of the bed of the river, should be carefully acquired.

17. You should then return northward ; and although Colonel Scott has recommended an elaborate system of levelling circuits, I hardly think the present state of the question would justify the requisite outlay. If, as he supposes, the Narra be unfit for an irrigating channel, much valuable time would have been lost, and expense incurred ; whereas, if what levels you do determine are carefully and accurately taken, and bench-marks at distances fixed, the only time lost, should eventually a more detailed levelling survey be found necessary, will be simply that of travelling back to the point from which levelling is to be resumed. You should take cross sections both to the east and west of the river. I will not hamper you by defining their exact distances, but I would say generally sufficiently far to determine the extent of country capable of irrigation, or to prove it beyond a doubt to be incapable of being so treated. Again, where you find desert or worthless land approach near the bed of the river, it would of course be useless to delay your progress by extending your levels across it, while, on the other hand, the vicinity of any canal or other work that may in any way affect the question would be sufficient reason for an additional cross section.

18. This careful examination of the river should extend up as high as Tujjul, where Captain Baker's survey terminates. On your arrival there, you should endeavour to find one of his bench-marks, and so join your levels on to

his ; and if you succeed in so doing, a few cross sections only need be taken between that place and Fukeerabad.

19. You should take sufficient measurements to enable you to make a plan of the river, showing its breadth and soundings at a fixed level.

20. Should you, at any period of your inquiry, be forced to conclude, on undoubted grounds, that it would not be remunerative to restore water to the Narra, an immediate report should be made to me ; but you should continue the work until you receive further instructions.

21. Having, in accordance with these instructions, arrived at Fukeerabad, one of your Assistants should continue to trace the Narra to its head, and also examine all its tributaries, while you carry out, with your remaining Assistant, the more immediate object of the survey, viz. to determine the best line of a feeder and the expense of forming it.

22. In the last part of the 14th paragraph of your letter No. 415, you suggest a line for the feeder, north, instead of south of Roree as proposed by Captain Baker. You should carefully examine the advantages of both lines, and, having selected that which appears to you to be the best, you should prepare an estimate of its cost.

23. To make this accurately, the soil, to the full depth of the required cutting, should be examined, either by sinking shafts or by boring, and as, if rock prevails, the work will be very expensive, the line which gives the minimum quantity of rock-cutting should be adopted.

24. You will be pleased to keep me informed of your progress monthly, reporting, however, intermediately in case anything should occur, or information be gained at all likely to lead to a modification of these instructions.

(Signed) H. B. TURNER, Major,  
Superintending Engineer, Sind.

*Kurruckee, 11th December 1851.*

No. 2607 of 1851.

GENERAL DEPARTMENT.

From the COMMISSIONER IN SIND,

To MAJOR TURNER, Superintending Engineer, Sind.

SIR,—I have the honour to acknowledge your letter noted in the margin, and

No. 1813, of the 11th December 1851, forwarding copy of Instructions to Lieutenant Fife regarding the Narra Survey.

to return you my thanks for the very clear summary of the present questions at issue contained in your instructions. They will, I think, greatly facilitate Lieutenant Fife's labours, and seem to me so

full and judicious as to require no remark from me.

2. When you can spare it, I shall be glad if you will return the Memorandum to me to be copied and returned to you, as I have, to save time, made no copy.

3. With reference to para. 3 of your letter, I may remark, that I had little doubt but that if water could be got into the Narra, an ample quantity of culturable land would be found at almost any part of its course. I was led to this belief from considering, 1st, that authentic history and tradition concur in stating that but a few generations ago there was more cultivation and a greater population on the banks of the Narra than exists now on those of the present Indus. 2ndly, That I have seen very little land in Sind, as far as Meerpoor, which is not culturable if water can be supplied to it. 3rdly, That even the Western Desert, when rain falls, affords, in every district, a large proportion of culturable land.

4. Still I was anxious that nothing should be undertaken till such reasoning had been confirmed by the observations of an able and intelligent officer, looking at the district with this particular object in view.

5. Regarding Colonel Scott's doubts of the fitness of the Narra for a channel, I did not myself, judging from the past history of the river, and what we now see in the Delta, expect them to prove well grounded; but I had no personal knowledge of the locality, and I considered that such doubts, expressed by so able and experienced an officer, were entitled to every attention. It seemed to me, however, a point on which accurate data for a decided opinion were wanting, and I was most anxious that Lieutenant Fife should not take either the fitness or unfitness of the channel as an established fact, but that he should look at the country with the feeling that the best line of the proposed channel was a point on which he was to make up his mind from what he saw.

6. You will see then that I quite concur with you in thinking it premature to design the feeder till the points in question are decided, but that my impression is that an ample quantity of culturable land will be found; and I further incline to the expectation, that if arrangements are made for pouring a regular supply of water annually into the Narra, at any point below where its channel becomes well defined, the channel will be found good enough to make it a very profitable speculation, though, till Lieutenant Fife examines and reports, it will still be doubtful whether or not the profits may not be increased by some mode of conveying the water more economical than by letting it run in the old natural channel.

7. I shall be glad if Lieutenant Fife will ascertain from the Zemindars, &c. as accurately as he can without personal examination, the names and boundaries of the Purgunnahs, or other local sub-divisions through which the Narra passes, or which any line he may choose is likely to intersect. This information will be found very necessary in any future adjustment of the cost and profits of the undertaking with his Highness Meer Ali Moorad.

I have, &c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind.

*Kurrachee, 22nd December 1851.*

No. 677 of 1852.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To the Right Honorable LORD VISCOUNT FALKLAND, G.C.H.,  
Governor and President in Council.

MY LORD,—With reference to Mr. Chief Secretary Malet's letter No. 10488, dated 5th November last, we have the honour to submit, for the information of your Lordship, a memorandum of instructions drawn up by the Superintending Engineer, Sind, for the guidance of Lieutenant Fife in the carrying on of the special duty to which he has been appointed, together with copy of a letter, No. 2607, dated 22nd December, on the subject of those instructions, from the Commissioner in Sind to the address of Major Turner.

We have the honour to be, &c.

(Signed) C. WADDINGTON, Lt. Col. Commandant,  
Chief Engineer.

„ J. SWANSON, Major.

*Bombay, Military Board Office, 27th January 1852.*

*Extract (para. 1) of Government reply, No. 936, dated 11th February 1852.*

1. I have been directed to acknowledge the receipt of your letter No. 677, dated 27th ultimo, with enclosures, and to inform you that the Right Honorable the Governor in Council has been pleased to approve of the instructions drawn up by the Superintending Engineer in Sind for the guidance of Lieutenant Fife in surveying the Narra River.

No. 55 of 1852.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To Major H. B. TURNER,  
Superintending Engineer, Sind, Kurrachee.

SIR,—In continuation of previous correspondence, I have the honour to submit my final report on the Eastern Narra.

2. In this report, it will be observed, I have not noticed the various theories that were mooted previous to the survey. They would only have had the effect of rendering the report complex and less useful for practical purposes. I have, however, given that portion of the subject relating to the abstraction of too great a quantity of water from the Indus, and on which point Major Baker expressed fears, careful consideration. I shall now endeavour to explain how Major Baker's misapprehension arose.



3. Major Baker, in the 3rd paragraph of his report on the subject, states that "from Fukeerabad to Janoojee the channel of the Narra is well marked, it is 20 feet below the level of the country, and from 300 to 600 feet wide;" and in the 11th paragraph, that "a reference to the profile taken along the Narra will show that the slope of its channel is nearly parallel to that of the Indus, but about 20 feet lower than its cold weather level." To give a general idea of the river, this description is sufficiently correct; and his clear, but not detailed report, plainly showed how easy it would be to supply the Narra from the Indus.

4. But, for actually carrying out the project, something more than a general description is required: accuracy and detail are necessary. In designing works to afford the supply of water, we have to deal not so much with the first seventy miles of the channel as with the first thirty, or such a limited length as may be supposed to materially affect the project. Observe what a difference takes place when the facts are confined to a certain portion of the river.

5. Three accurate sections of the Narra were taken last season. In the first, immediately below Trigadce, the extreme width was 183 feet, extreme depth 20.45 feet, area of section 2434.79 square feet. In the second, a little below Lehra, the extreme width was 224 feet, extreme depth 18.58 feet only, area of section 2268.50. In the third, some distance below Lehra, the extreme width was 181 feet, extreme depth 20.47 feet, and area of section 2723.26 feet; and besides these sections, the width of the channel was taken in several other places, the same result being obtained, viz. that the average width was 200 feet, and that it gradually increased lower down. In my report, I think I have clearly shown how materially this smallness of capacity of the Narra affects the escape of the water from the supply channel.

6. Next, with respect to the slope of the bed of the Narra, it is quite true that at its head the bed is 20 feet below the cold weather level of the Indus, and that at Tujjul, 70 miles lower down, it is nearly as much, but between those places this depth is not maintained. At Janoojee, about 20 miles from the head, the bottom of the Narra is only 12 feet below the cold weather level of the Indus, and below Saida, 20 miles further down, or 40 miles from the head, it is only 10 feet below the Indus. With the depth at Tujjul we have little to do, the distance is far too great for the depth at that place to affect the stream in the upper reaches.

7. It was the want of data in respect to the capacity of the Narra in its upper part, and the overlooking of the want of fall to Janoojee, which, I think, led Major Baker, when sketching out the project, to take an exaggerated view of the danger of drawing too much water from the Indus. Were the Narra 600 feet wide near its head, and were the depth of 20 feet below the Indus continuous instead of occasional, the question would wear a different aspect. As it stands, the supply channel would only be liable to enlargement during the first few seasons after it is opened, and even then the liability would not be great.

Indeed, had we not the assistance of occasional large floods to keep down the accumulation of silt in the Narra, there would be great reason to fear that at no very distant period after the opening of the supply channel it would become almost impossible to get an ample supply of water down the Narra.

8. My project for supplying the Narra, it will be observed, is framed to meet the present wants of the country in respect to water. It has not been forgotten, however, that it is possible a larger or even perennial supply may hereafter become desirable. But even supposing the perennial supply to be at once necessary, it is plain that by carrying out the more simple project first, and observing the actual effect in the irregular natural channel of the Narra, we should obtain accurate data for designing works for a perennial supply. Let it be seen in actual practice what effect the artificial supply has in causing a silt deposit near the head of the Narra, and what quantity of water it would be necessary to have in the Narra for its navigation, and then we shall be able to see clearly what success would attend a project for the perennial supply.

9. In the course of a day or two I shall submit a proposal for continuing the survey in the Hyderabad districts during the approaching season.

I have, &c.

(Signed) J. G. FIFE, Lieutenant,

On Special duty.

Kurrachee, 16th. September 1852.

*Report on the Eastern Narra, from its head near the Town of Rorce to its confluence with the Poorann near Wanga Bazar ; its sources of supply ; the nature of the country along its banks ; the cultivation and revenue derived ; the effect of throwing a regular supply of the Indus water into it ; and the probable return on the outlay required to carry on the project.*

1. To the south-east of the town of Rorce there is a low tract of land, which lays between the rocky range running south from that place and the sand-hills of the Eastern Desert of Sind. In the centre of this tract the head of the Eastern Narra is formed, for though the supply of water it receives sometimes leaves the Indus 100 miles higher up the country and reaches the Narra by means of a depression, it is only from the centre of this tract that the channel becomes well-marked and continuous. Near the village of Kharee the channel is 200 feet in width and 20 feet below the level of the country. Converging on this locality there are numerous smaller feeding channels, which, though wide and deep where they enter the Narra, rapidly diminish in capacity towards their sources. The largest of these comes from the north from Fukeerabad, three others come from the vicinity of Birha, and further south there is a large one near Lehra. Besides these there are many others, but they are smaller and extend only a short distance from the Narra.

2. When, during the inundation, the Indus attains its maximum height, it frequently overflows its eastern bank at various points between Roree and Bhawulpoor. The water, after escaping over the bank of the river, passes, by means of the depression mentioned in the preceding paragraph, southwards to the head of the Narra, into which it is conveyed by the feeding channels, though, when the supply is great, it also completely inundates the valley from the sand-hills on the east to the rocks on the west side. It is these floods which form the Narra supply. They are very variable: they depend on the height the Indus attains, the time which it remains at or near that height, and the direction its stream takes near the points of overflow; and these vary every season. Hence it is that the Narra's supply is so uncertain. During some seasons, no water at all reaches the Narra; during others the supply is so great, that it not only fills the channel of the Narra but also completely inundates the country along its banks as well. Sir Alexander Burnes mentions that in 1826 a flood from the Narra reached Luckput, cutting through the Allah Bund, a natural obstruction caused by an earthquake. In 1833 a flood passed down as far as Wanga Bazar. In 1843 Major Baker saw near the head of the river the recent marks of a flood which had risen eighteen feet. In 1844, he reported that the water did not rise more than four feet at the same place. Last year a flood rose twenty-three feet above the bed of the river, filling the channel and flooding the country along its banks to a depth of two or three feet as well. This flood only lasted about fifteen days. Had it lasted longer, or had the numerous large bunds along its course through the Hyderabad districts not been completely dry, it would have reached Wanga Bazar. During the present season another large flood has passed down. Few seasons pass without some water reaching the Narra, but generally the floods are not great enough, or do not last long enough, to be of any practical use.

3. After passing between the villages of Ghurree and Lehra, the channel of the Narra increases in capacity till, at Salehput, it attains a width of about 300 feet, and at Janoojee, 16 miles lower down, it is 600 feet in width.

4. From the village of Trigadee to Janoojee the valley of the Narra is an alluvial plain, and well adapted for almost every kind of cultivation.

5. Below Janoojee both the river and country change their character. The channel increases in width, diminishes in depth, and becomes very irregular. The country, which is denominated the Thurr, is covered with enormous sand-hills, extending on every side as far as the eye can reach, and presenting a singular but very desolate appearance. Occasionally, however, between the sand-hills rich tracts of alluvial soil are met with. Immediately below Janoojee one of these is found, and which, when the flood is great, receives its supply from an overflow below Salehput. Below the village of Saida another is met with, called the Rainee, and which was formerly watered by a flood said to come from near Bhawulpoor. During the last season some of this tract was fertilized by water from the Narra passing up it. Besides these there are

many smaller tracts, some of which, from being almost surrounded by sand-hills, retain water for a considerable period after the flood has subsided. Of these dunds, as they are termed, there are two near the village of Sohara, one about six miles below Saida, and another at Joorearrow. The two last mentioned are each about two miles in circumference.

6. At Tujjul the valley becomes much wider, the sand-hills receding to a distance of five or six miles from the river. But the plain between is covered with small hillocks, and there is very little culturable land. The occasional patches of soil met with are thin and sandy. The channel of the river increases greatly in width, but its depth is inconsiderable. The country continues of the same character as far as Togacha, a distance of fifty miles, the channel of the river being in some places between two and three thousand feet wide, the banks low and sandy, and covered with not very luxuriant jungle.

7. In the neighbourhood of Togacha an important change takes place both in the country and in the river. The sand-hills on the west bank terminate, and in place of them there is a beautiful alluvial plain, extending without interruption the whole way across to the Indus. On the east bank, though the sand-hills still continue close to the river, the valleys between them are occupied by numerous dunds, in the beds of which there is excellent soil. Altogether there are nearly 400 of these dunds (lakes as some of them deserve to be called), some of which are three miles in length, a mile in breadth, and in places thirty feet deep. They are generally connected with the river by narrow channels, and are so much below it, that until they are filled, the river makes but little onward progress. Sometimes they occur singly, at others in clusters of thirty and forty all connected with one another; and where the jungle on their shores is luxuriant they are most picturesque.

8. The river, in place of flowing through one broad channel, throws out two branches a short distance above Togacha. The eastern branch skirts the foot of the sand-hills, supplying many of the dunds, and rejoining the main stream at Puttaee. The western branch, as far as Mittrow, flows through a sandy soil, but beyond that place it reaches the alluvial plain, where the channel disappears, and the water spreads over and fertilizes the plain for many miles, ultimately returning to the main stream at Bukkar, about fourteen miles lower down.

9. At Bukkar the Narra is much smaller than it is higher up, and at Cho-teearce and Mitta Khan-ke-Tanda, a few miles lower down, it is not more than 500 feet wide. The channel is through alluvial soil.

10. Below Mitta Khan-ke-Tanda the river throws out a branch, the waters of which, after passing Sirenwarree, spread over the plain and fertilize it. The water returns to the main stream near Koobah. The river itself turns eastward into the Thurr, and flows through numerous dunds, all traces of the channel being lost. After filling nearly fifty of these dunds it emerges from the Thurr again at Khetee, where it has a well-defined channel.

11. At Kippra the channel is through alluvial soil: it is 1,300 feet wide and

5 feet in depth. About two miles below the village, however, it almost vanishes; there is a depression about 1,100 feet wide, but it is only 3 feet below the plain. When a large body of water comes down the river, a great deal of it escapes over the west bank above Kippra, and, after flooding and fertilizing a large tract of land, returns to the river at Dilliar, about ten miles further south. On such occasions the land between the river and the sand-hills is also flooded.

12. From Kippra to Ding the course of the river lays through the alluvial plain, though occasionally the sand-hills are close to it. The channel is wide but very little below the country. Immediately below the village of Ding there are the traces of a bund, which was thrown across the channel by one of the Meers, with the view of forcing the water into the plain. It was, however, turned and carried away by the stream during a heavy flood.

13. Between Ding and Choondawah the sand-hills recede eastward to Oomerkote, forming a kind of bay, across which the river takes a direct course *viâ* Trimmoo. The channel in some places is large and well-defined though not deep; in other places it is scarcely perceptible. During high floods the whole country from Oomerkote to Soomara, a distance of eighteen miles, is sometimes under water. The land on both banks is excellent, and fit for almost any kind of crop. A short distance above Choondawah there is an old canal, which runs towards Oomerkote. It is about 30 feet wide, 4 feet in depth, and in a very good state of preservation. It was formed by one of the Kaloras, for the purpose of transporting stone for the construction of a fort at Oomerkote.

14. From Choondawah to Nowakote the Narra, or the "Hakra," as it is termed in this part of the country, skirts the foot of the Thurr. There is good soil, however, along its banks and in its bed; near Nowakote the channel is very large and deep.

15. At Nowakote the river flows in two channels. The largest one is termed the "Sairce Dhora," and runs in a south-westerly direction to Wanga-ka-Gote, where it joins the Pooraun. The other channel, still under the name of the Hakra, continues to skirt the foot of the Thurr for about thirty miles, after which it joins the Pooraun below Wanga Bazar.

16. From Wanga Bazar the waters of the Narra pass by means of the channel of the Pooraun to Luckput, where, after completing from the head of the river a course of 300 miles, they enter the sea. As far as Roma-ka-Bazar, in the vicinity of which place the British territory terminates, there is a great deal of culturable land, but below that place, within the possessions of the Rao of Cutch, the soil is said to be much impregnated with salt and very unfavourable.

17. In proportion to the extent of country there are very few permanent villages, or even traces of villages, in the valley of the Narra. Those near the head, "Lehra," "Ghurree," Salehput," and "Barg," and those within the Hyderabad Collectorate below Togacha, "Mittrow," "Sirenwarree," "Mitta Khan-ke-Tanda," "Choteearee," as far as Wanga Bazar, are all permanent, but none are large, though, from the ruins of musjids found near some of them, they

were evidently places of some importance formerly. Those between Barg and Mittrow are all temporary, the houses being constructed of brushwood only. It may be assumed, therefore, that the population was never very great, though it is likely that formerly, whenever the supply of water was more abundant and regular than it has been of late years, there were many more inhabitants than there are now.

18.. The present inhabitants gain a livelihood by rearing cattle, feeding flocks, fishing, and by carrying on a grain export trade with Jeysulmere and the States outlying the Thurr; and whenever that part of the country is blessed with rain, or the Narra brings down any water, they eagerly avail themselves of the facilities for raising a crop, no matter how small. Whatever rain may be to those residing near the Indus and within the influence of its fertilizing effects, to the inhabitants of the Narra valley it is truly a blessing: they are not only enabled to obtain comforts by means of their crops, but the Thurr, after rain, yields an excellent grass for the cattle, thus giving them an additional advantage.

19. Whenever the Narra lands are flooded to an extent greater than the people living along its banks can cultivate, others living near the Indus, after reaping the Khurreef crop in September, readily travel across to the Narra for the Rubbee crop, which, from the small capital required, holds out to the poorer classes peculiar inducements to cultivate.

20. No irrigating canals are met with near the Narra, and with the exception of the dunds, in which cultivation is carried on the whole year round, and patches of land on the banks and in the bed of the river fertilized by occasional rain during the hot season, the cultivation carried on is entirely Rubbee, for which the soil is almost everywhere well adapted. The produce consists of wheat, barley, moong, syree, janiba, and cotton, and from the dunds there are also jowarree and chowra and other vetches. Some of the latter are said to grow with extraordinary luxuriance, the light soil found in some parts of the dunds, with the great heat and abundant supply of water, being peculiarly favourable to them. The dunds are also famous for their fisheries. The fish attain an enormous size, and, as the dunds gradually dry up, are easily caught.

21. About twenty years back, when the last great flood occurred, the greater portion of the produce was at once exported to the States beyond the Thurr, a small quantity only being carried towards the Indus. This is an important fact when considered in reference to the revenue of Sind, for it is evident that the production of a large quantity of grain in the Narra valley is not likely to affect materially the quantity already annually raised near the Indus, by causing an overplus in the country.

22. The statements which have been made regarding the revenue formerly obtained from the Narra are very vague and conflicting. By some it has been rated as high as six laks; by others at two laks. From the immense quantity of land watered by the Narra during great floods, and the fact of the smallness of the population on its banks in the Hyderabad Collectorate being no

impediment to the cultivation of a large Rubbee crop, the requisite number of people coming from the vicinity of the Indus, where, during the cold season, they have but scanty employment, there can be little doubt that one statement frequently made by the people does not exceed the truth. This sets the revenue of the country south of Togacha down at two laks during very favourable seasons. The revenue of the upper portion of the valley, from Togacha to its head, was stated to be about Rs. 60,000 under similar circumstances; the greater part of this was obtained at the head of the valley. This brings the total revenue up to two laks and sixty thousand Rupees.

23. It is not to be expected that, at this space of time, the current reports of the former revenue of the Narra valley can be relied on for accuracy. It is likely they are exaggerations; still they must have had some foundation, and, considering the enormous quantity of good land fertilized, at a rough computation 250 square miles, the number of people near the Indus who have no employment during the cold season, and the peculiar inducements the Rubbee crop holds out to them to cultivate, there is every reason to believe that, during favourable seasons, the revenue must have been very great, and that the statements fixing it at two laks and sixty thousand Rupees do not exceed the truth.

24. The flood which passed down the Narra last year only reached Sirenwarree. Its strength was expended in filling about 100 of the dunds which had been quite dry for years: it had just reached the alluvial plain from which the greater portion of the revenue was formerly derived. Its useful effects were confined to the head of the Narra, about half of the dunds, and the edge of the alluvial plain from Mittrow to Sirenwarree. The revenue obtained was as follows:—

From the Jaghire lands at the head of the Narra from Fukcer- abad to Barg, about .....	Rs. 15,000
From the lands between Barg and Sohara.....	„ 5,000
From the lands between Sohara and Ubrow, including about 35 dunds. This portion of the valley constitutes a part of the possessions of Meer Ali Moorad; no account of its revenue has been obtained, but it cannot have been less than.....	„ 5,000
From the lands from Mittrow to Ubrow on the west bank, and from those on both banks from Ubrow to Sirenwarree, includ- ing one hundred and sixty dunds (see Appendix) .....	„ 10,000
Total....	Rs. 35,000

The Collector of Hyderabad states that the revenue would have been greater but for a blight which injured some of the crops.

But for the jungle which has sprung up during the last twenty years and covered a great deal of good land near the Narra, the revenue would have been much greater. A great deal of land was cleared last season, and if the supply of water were more regular, the whole would soon be cleared again.

## PART II.

25. From the foregoing description, and a reference to the sketch map of the course of the Narra with the cross sections, it will be observed that the channel is of great capacity only where it is of least consequence, for the purposes of cultivation, that it should be completely filled. At its head, and indeed some distance below Salehput, the channel is of very moderate capacity, and might easily be filled by an artificial supply. Where the country is comparatively sterile, from Janoojee to Togacha, the channel is very large; but below Togacha, where the land is so excellent, the channel becomes smaller, and below Kippa it nearly vanishes altogether, while, from that place to near its junction with the Pooraun, it is nowhere of a capacity so great as to make a project for filling it to useful purpose at all difficult.

26. It will also be seen that there is abundance of low land near the Narra which it would be easy to inundate for the Rubbee crop, that where the banks are high Khurreef might be carried on, and that in the numerous dunds there are peculiar facilities for admitting and retaining water for both fisheries and cultivation.

27. It will, moreover, have been noticed, that owing to the scantiness of the present population of the Narra valley, a large revenue could only be obtained by means of an extensive Rubbee crop, which would be principally raised by a migratory class of people from the vicinity of the Indus.

28. To obtain a Rubbee crop from the low lands near the Narra, and a small Khurreef crop, or as much as the present population could cultivate, from land secure, or which might easily be rendered secure from inundation, and to obtain the revenue from the dunds, an abundant supply of water during the inundation, or from April to October only, is necessary. A cold weather supply would be of little use, if not a positive disadvantage: it would flow through lands already watered, and it might interfere with the cultivation on the low lands. For the purposes of navigation, or even for irrigation, supposing a perennial canal were carried from the Narra on to the plain below Mittrow, such a supply may at some future time become desirable, but for the present it would only have the effect of increasing the expense of the project.

29. To throw a regular and abundant supply of the Indus water into the Narra, there are, at its head, extraordinary natural advantages. The Narra, near Kharee, where its channel is well defined, is only eleven miles from the Indus; the bottom of the channel is twenty feet below the cold weather level of the Indus; and the Indus at Roree, where it passes through a deep channel in the rock, is liable to no variation in its course. Thus there is an ample fall to draw off with ease a large supply of water, and there is no liability of having that supply rendered uncertain from the Indus forsaking its present course.

30. From the proximity of the channel of the Narra to the Indus, and the great difference of level between them, there is, however, a liability of more



water being taken from the Indus than could be spared, or even of transferring the Indus itself to the valley of the Narra. This liability certainly, as will presently be seen, is very slight, and would probably soon be entirely removed if a regular supply of the Indus water were thrown into the Narra. But still an event fraught with such serious consequences deserves, no matter how slight the chance may be, the most careful consideration and the most effectual remedy.

31. An undue quantity of water might be withdrawn from the Indus, or the Indus might change its course through the effect on the country of the large floods which sometimes escape from it into the Narra. It will be observed by a reference to the profiles of the country between the Indus and the head of the Narra in Sheet No. 2, that the plain from the village of Kotree slopes at the rate of about two feet per mile to the edge of the Narra. In consequence of this great fall, the flood water, when the country is inundated near Kotree and Birha, runs with considerable rapidity into the Narra. It is the action of this water which has formed the numerous feeding channels shown in the map. Besides forming the feeding channels, the flood also cuts up the plain wherever it meets with any resistance: after it has passed, the roots of bushes are sometimes left exposed, the soil having been cut away. With every great flood the feeding channels undergo enlargement, as well as the Narra itself. Doubtless this alteration proceeds very slowly, for the soil is tenacious, and great floods occur only at considerable intervals; still there is no correcting agency at work when the supply of water is moderate. No silt is deposited; the flood water, of which the Narra's supply exclusively consists, is quite clear; the silt is thrown down directly the water leaves the Indus, and never reaches the Narra. Some of these feeding channels, by continually extending, might at length reach the Indus. There would then be a direct and uncontrolled communication between the two rivers, and this might lead to an undue quantity of water being drawn from the Indus, or even to the Indus changing its course. Obviously the most effectual way of averting so serious an evil, is to create a compensating deposit of silt in the channel of the Narra. This would be effected by throwing, under proper restrictions, a regular supply of the Indus water into the Narra.

32. In forming a supply channel from the Indus to the Narra to meet the wants of the valley in respect to cultivation, and which would also have the useful effect explained in the preceding paragraph, its liability to enlargement by the action of the stream, and the consequent risk of taking too much water from the Indus or of causing a change in its course, must next be considered. It will be seen by a reference to the profile of the lands near the head of the Narra valley in Sheet No. 1, that the bottom of the Narra near its head is about twenty feet below the cold weather level of the Indus, and that the bed has a fall of about six inches per mile as far as Salehput, but that from that place to Janoojee, a distance of sixteen miles, it has no fall whatever, and that at the latter place it is only twelve

feet below the corresponding point in the Indus parallel to it. It will also be remembered that the capacity of the Narra at its head is by no means great, and that it continues to be very moderate for a distance of many miles. The effect of these peculiarities in the Narra, on the subject under consideration, are obvious; a large body of water could not escape from the supply channel down the Narra at a low level. Any considerable body of water would completely fill the Narra at its head from its want of capacity, and though, lower down, the width increases, the bed has no fall. Hence, supposing the Indus to have attained its maximum inundation height of thirteen feet above the cold weather level, and that a sufficient supply were thrown into the Narra to fill it, the Indus would only be twelve feet above the Narra and at a distance of eleven miles, a fall which, with ordinary precautions, need cause no apprehension. The water could only escape down the Narra at a low level when very inconsiderable in quantity, or when it would have little or no scouring power in the supply channel. But the peculiarities in the form of the channel of the Narra would have another important effect, supposing a regular supply of the Indus water heavily charged with silt were thrown into it: the channel would rapidly diminish in depth, a large quantity of silt would rapidly accumulate between Salehpur and Janoojee, where there is a want of fall in the bed, and this would be followed by an accumulation at the head of the river. The slope of the bed from the head to Janoojee would become more uniform, and the depth below the Indus reduced. The occasional floods to which the Narra is liable would no doubt tend to keep the accumulation of silt down, and they would be useful in this way; but there can be no question that in a channel of so singular a form the accumulation of silt would to a certain point predominate.

33. The tract of country over which the waters of the Narra may be made available for the purpose of cultivation is very extensive; and hereafter, when works for the purpose of irrigation are applied, the extent of country cultivated will be limited by the quantity of water. For the purposes of navigation also a very abundant supply will be requisite. In determining a line for the supply channel therefore, it is important that none of the fall should be thrown away by adopting a circuitous route, and that the supply channel should enter the Narra where its capacity is large, or where, supposing it should become desirable to increase it, the increase may be easiest effected, ample provision being of course made to prevent the supply channel at any time increasing to a size greater than may be required.

34. The area of a mean section of the Narra, obtained from sections opposite and below the village of Lehra, is 2,828·85 square feet, and the slope of the bed below that place is 6 inches per mile. These conditions, according to the formula of Du Buat, make its discharge, when full, 8,413 cubic feet per second. During the inundation the maximum height attained by the Indus above the zero of the water gauge in Fort Bukkar, or above the cold weather level, is 13 feet, but the river only remains at this height for a few days in the

season, the common height being about 11 feet during the months of June, July, and August, and considerably less from April to June and from August to November. In the following projects for filling the Narra, the supply channel gives the required discharge of 8,413 cubic feet per second, with the Indus at 11 feet above zero.

35. In the map of the country between the head of the Narra and the Indus (Sheet No. 2), the red dotted lines show the various lines of levels that were taken last season. From these three different lines for the supply channel were selected. The project for each has been separately calculated and estimated. The line for the first project (coloured green), leaves the Indus below the town of Roree; thence it runs close past the village of Ubbecjano, and through the opening in the hills at Arore, and from that place goes direct to the nearest point of the Narra below the village of Kharce. The line for the second project (coloured yellow), leaves the Indus immediately above Roree, and then skirts the range of hills as far as Arore; from Arore it runs direct to the nearest point of the Narra, corresponding in this respect with the first project. The third project (coloured red) coincides with the second as far as the village of Kumbra, but from that point it takes a more southerly direction, and joins the Narra below Lehra, following in the three last miles of its course the direction of one of the natural feeding channels of the Narra.

36. The line for the first project very nearly corresponds with a line of levels taken by Major Baker to demonstrate the feasibility of supplying the Narra from the Indus. It differs from it only in being rather shorter, going inside instead of outside the village of Ubbecjano, and running into the Narra at its nearest bend somewhat below the point where Major Baker entered it, instead of opposite the village of Trigadce.

37. The head of this channel passes between two detached rocks (see Sheet No. 3) below Roree. At 620 yards from its head it is cut through the rock. Embankments of stone connect the detached rocks with the bank of the river. These would be constructed with the material removed in cutting the rock further on. They are necessary to prevent the water entering the head of the supply channel from two or three different points, in which case, there would be a likelihood of their all failing on the subsiding of the river. There is no clay between the rocks; there is nothing but loose sand, which is swept away during the height of the inundation, a fresh accumulation taking place as the river subsides. A great deal of the remainder of the material removed in the rock-cutting would be used in facing the earthen slopes, above and below where the channel passes through the rocks, to preserve them, as the channel makes rather an abrupt turn, and the stream would otherwise act injuriously on the banks.

38. The bottom of the channel is carried on a uniform slope from the cold weather level of the Indus, to within five feet of the bottom of the Narra, the fall being at the rate of about one foot per mile. This fall is sufficient to secure

a good stream, and five feet would probably be the extent to which the bed of the Narra would rise were an artificial supply regularly thrown into it. If the bed of the Narra were to assume a uniform slope at the rate of about nine inches per mile, or the same slope as the Indus, upwards from Janoojee, the depth where the supply channel enters it would be reduced from twenty to twelve feet. This would make it three feet above the bottom of the supply channel; as, however, the occasional heavy floods to which the Narra is liable would tend to keep down the accumulation of silt, the probable reduction in the depth of the channel has been taken at five feet, or up to the bottom of the supply channel. In this project the supply channel has a width at bottom of 183 feet, the depth of the water being eleven feet; when the Indus is at that height, its slope, velocity, and discharge are as follows:—

Slope of Bed.	Sectional Area of Feet.	Velocity at Surface per Second.	Velocity at Bottom per Second.	Mean Velocity.	Discharge.	
					Theoretical.	Required.
1 in 5106	2198.16	5.71 feet	1.93 feet	3.824 feet	8406 C. ft.	8413 C. ft.

In the above, and in the succeeding calculations for the velocity and discharge, the formula of Du Buat has been used. The channel is nearly fifteen miles in length, and the estimate amounts to Rs. 6,05,562.

39. The peculiar recommendation of this project is, that in case of a large supply of water being required during the cold weather, the head of the channel which lays between the rocks forming the banks of the Indus is not liable to be masked by an extensive accumulation of silt and the supply thus rendered uncertain.

40. The objections to it, however, are great; the circuitous course greatly increases the expense, both from making the channel longer, and, by reason of the fall being disseminated over a greater base, larger in section than would be required in a more direct route. But there is a greater objection than the increase of cost. From the addition of nearly four miles to the length, there is a serious waste of fall. This will be apparent by an inspection of the profiles in Sheet No. 2. If a body of water sufficient to be of any practical use were thrown into the Narra during the cold season, there would be but little difference of level between the two rivers; the fall would be insufficient. It would be almost impossible to keep the channel open, or to get anything like an ample supply through it. Another disadvantage in the project is, that the channel would not enter the Narra at an advantageous point, the capacity being less near Kharee than it is lower down. The channel would, moreover, cross the country from Arore to the Narra in a direction oblique to the course of the floods, which, as indicated by the various feeding channels, run in a more southerly direction than the line of the channel. This is a serious objection; a strong stream

would be created outside the embankment of the supply channel from Kotree to the Narra, a distance of about four miles. This would result either in the formation of a large channel, or in the embankment being cut away and the flood water forcing its way into the supply channel, which might then be enlarged to a serious extent, and by an agency over which we should have no control. Both the last objections might be alleviated by taking the supply channel into the river below Lehra, but this would increase the already large estimate to about Rs. 6,40,000.

41. In the second project the supply channel leaves the Indus immediately above Rorec and at a point where the channel of the river is subject to but very little variation. At 1,130 yards from its head it is cut through rock at the end of a spur, and between this point and Arore it passes through three other spurs at distances of about a mile apart. At each of the points where it passes through rock the material removed would be used for facing the slopes of the channel both above and below the rock-cutting, to prevent the stream, which might be thrown out of its true direction on suddenly meeting the rock, acting injuriously on the earthen slopes. The bottom of the channel, like that in the first project, is carried on a uniform slope from the cold weather level of the Indus to within five feet of the bottom of the Narra; the fall obtained being about one foot four inches per mile. This will ensure a good stream, at the same time that any tendency the supply channel may have to enlargement would be most effectually controlled by the rock-cuttings at regular intervals. The channel is 155 feet wide at bottom, the depth of the water being eleven feet. The slope, velocity, and discharge are as follows :—

Slope of Bed.	Sectional Area of Feet.	Velocity at Surface per Second.	Velocity at Bottom.	Mean Velocity.	Discharge.	
					Theoretical.	Required.
1 in 3826	1882.13	6.50 feet	2.40 feet	4.465 feet	8404 C. ft.	8413 C. ft.

In respect to the slope of the bed in this project, it is rather less than that of the Ganges Canal at its head. The channel is, however, somewhat larger than the Ganges Canal, and the discharge is about one-sixth greater. The channel in this project is only eleven miles in length. The estimate amounts to Rs. 4,49,875.

42. The advantages of this project are, that from the route being direct a great reduction in the cost of affording the supply is effected, and that, while there is no waste of fall, there is perfect security, by means of the rock-cuttings, against any undue enlargement of the supply channel.

43. The objections to the project are, that an accumulation of silt might take place in front of the head of the channel, rendering the cold weather supply, should it ever be required, at times uncertain, and that, like the first project, the channel, as it approaches the Narra, crosses the direction of the floods

obliquely. The first objection is not so serious as it at first sight appears. It is impossible to prevent the mouth of a channel, filled from the Indus, silting up to a certain extent as the river subsides after the inundation. Under any circumstances, therefore, it would be necessary, in order to ensure a good supply during the cold season, to close for a time and clear out the channel at its head, and, while that clearance was being effected, a passage through the accumulation of silt in front of the head, should any have taken place, might also be cleared. The channel least liable to have its supply cut off by a deposit of silt inside it, is that which provides the most ready escape for the water from the river, and this evidently depends on the slope of the bed, in which respect this project possesses an advantage over the former one.

44. The third project differs from the second only in the direction of the channel between Kumbra and the Narra. The channel is of the same dimensions, has exactly the same fall per mile, and has the same security against undue enlargement. But it has the additional recommendation of running parallel to the direction of the floods instead of obliquely across, and of entering the Narra nearly three miles further south, where the capacity is greater. Whether considered in respect to the present purpose of affording an ample supply during the inundation, or in respect to any future plan for increasing that supply, or of making it perennial, this project possesses great advantages over the two preceding ones. And those advantages are obtained at no great expense; for though, from entering the Narra further south, the length of the line is increased, the cutting below Kotree is lighter than in the other projects, while from following in the three last miles the course of a channel already in existence, a still further saving is effected. The length of the line is thirteen miles. The estimate amounts to Rs. 4,77,805.

45. The only works which would be necessary, besides those connected with the supply channel, are some earthen bunds across the dund-feeding channels in the Hyderabad districts, to prevent the water running into them when not required. Some of the largest dunds would not require re-filling oftener than once in three or four years, and even then some of these would not require to be completely filled, for at a high level their shores are steep, consequently during the first season after being filled but little land would, on the sinking of the water, be left exposed for cultivation. It would therefore merely waste the water filling them to a high level. Many of the smaller dunds would require a fresh supply of water every season. These bunds will not entail any great expenditure; their number and position, and the arrangements for filling the dunds, will be decided during the approaching season, and when it has been seen in actual practice what arrangement would give the greatest revenue with the least expenditure of water. The detail accounts of the revenue obtained from the dunds during the past season will contain a great deal of the information required.

46. The revenue that would be derived from throwing a regular supply of water into the Narra would principally arise from the cultivation of the lands

south of Togacha, in the Hyderabad districts, though the water would be of use also at the head of the river, and occasionally even between Tujjul and Togacha. As the Narra between Togacha and Wanga Bazar has a course of about 120 miles through alluvial soil, and the channel affording the supply of water would only have to be formed for a distance of thirteen miles, it would appear almost certain, that even supposing the cultivation were confined to the Hyderabad districts, and that a narrow strip of land along the course of the river only were brought under cultivation, the revenue obtained would amount to a large per-centage on the outlay. But when it is also considered that there are other points in its course, as at its head, and even below Wanga Bazar, where the water would also be useful, though perhaps not to so great an extent, the probability of the project yielding a large return becomes a certainty. It is, however, extremely difficult to make any estimate of the probable return; for though the return arising from the artificial supply alone may be computed, it would fall far short of the average revenue that would be obtained by means of natural and artificial supplies together. With the dunds previously filled, and all escape of the water in their direction prevented, the effect of any sudden additional supply from floods to that already in the river, would be to double or treble the quantity of low land inundated, and to increase the revenue in the same proportion. It is evident that a computation of the revenue obtained from the artificial supply alone would give a minimum estimate. This estimate will, however, suffice to show what great pecuniary gain may be expected to arise from the project. The revenue obtained last season from the low lands between Mittrow and Sirenwarree and one-half the dunds only, was Rs. 10,000. That for the whole of the dunds, and for the whole of the low lands from Mittrow to Syud-ke-Gote may therefore be taken at ..... Rs. 20,000

The revenue of the lands from Syud-ke-Gote to Wanga Bazar, a distance of 76 miles, on the supposition that only the river bed, in which there is room for two beegahs in breadth, and a strip of land one beegah in width on either bank, is cultivated, thus giving about 10,000 beegahs, of which say three-fourths or 7,500 are Rubbee at ..... 2 8 0 = 18,750 and one-fourth or 2,500 Khurreef at..... 1 8 0 = 3,750 would be ..... „ 22,500

The revenue of the lands from Trigadee to Barg, at the head of the Narra, probably ..... „ 5,000  
 From Barg to Sohara, say half the last year's revenue ..... „ 2,500  
 From Sohara to Jukrow on the west bank, and to Ubrow on the east, half of last year's revenue, the river channel being very large and consequently disadvantageous..... „ 2,500

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Total.... Rs. 52,500

This revenue on the estimate for Project No. 3, amounting to Rs. 4,77,805, gives a return of 11 per cent. per annum. This is the return that would be derived immediately after the opening of the Narra. As the jungle is cleared away and the people become more numerous, it would be greatly increased.

47. The land from Trigadee to Barg is Jaghire land. But as this yields nothing except when great floods occur, and as it would derive certain and immediate benefit from the project (indeed it would be inundated every year) a large proportion of its revenue would be due to Government.

48. Until the boundary of Meer Ali Moorad's portion of the valley between Sohara and Togacha is determined, it is of course impossible to state the exact extent to which he would be benefitted by the project. Only Rs. 2,500 have been inserted for this part of the valley in the estimate. But though the immediate return for this part of the valley would be small, it is very likely that rapid improvement would take place in the soil close to the river from the silt deposit, which the great breadth of the river there would favour. If this were to occur, it would have the effect of adding greatly to the revenue of this portion of the valley.

49. It is very doubtful whether the Rao of Cutch would derive any benefit from the project. The soil where the channel of the Pooraun passes through his possessions is said to be very unfavourable, and from the great size of the channel and the comparatively small quantity of water that would reach Luckput, the water would be at too low a level to be of much use. At Luckput some revenue in the shape of duties might be raised on the exports and imports, supposing the Narra to prove useful for the purposes of traffic, but this would evidently be a disadvantage to the British possessions. It would have the effect of checking, to some extent, the export of grain, which, perhaps, might otherwise be brought down from Upper Sind, where it is so cheap and abundant, as well as from the valley of the Narra itself. In place of getting the Rao of Cutch to bear any part of the expense of the project for such uncertain advantages, it would perhaps be better to get him to forego export and import duties at Luckput.

50. For the purposes of navigation the Narra would be well adapted. It would be open for country boats during eight months of the year, and from being smaller and consequently less variable in its channel than the Indus, the upward passage, a work of such difficulty and time on the Indus, would be easily and quickly made. From being smaller, moreover, the strong southerly winds which blow during the hot season would cause no danger to the boats by raising a sea, as is so frequently the case on the Indus.

51. The opening of the Narra in the manner recommended in this Report, is the first only of a series of works which might be carried out for the improvement of the country through which it flows. At the villages of Mittrow and Sirenwarrec, where, it will be seen by the map, the river has a south-easterly course, there are peculiar facilities for forming canals, to convey water,



to lands beyond the reach of the floods, and where the Khurreef crop might be extensively cultivated without interruption. The branches of the river at those places bring the water actually on to the plain. A suitable site near Mittrow might be selected for a perennial canal, should such a work ever become desirable. It might be possible, by carrying small and inexpensive bunds from the vicinity of those places, to prevent a great part of the flood water from returning to the river. The plain slopes from the north-west. Bunds carried along in a southerly direction would carry the water farther away from the river, and thus extensive tracts of land might be yearly fertilized for the Rubbee crop, and there are doubtless many other points in the course of the river below Sirenwarree where there are facilities for forming ordinary canals.

52. Those in authority are doubtless well aware of the social and political advantages that would arise from throwing a regular supply of water into the Narra. The condition of the present needy population would be immediately improved. The people now scattered about the Thurr, and earning an uncertain and scanty subsistence from their flocks, would probably make the banks of the Narra their permanent abode, tilling the soil as well as tending their flocks, while it may also be expected that the cultivation and fisheries would induce some of the poorer classes to come even from Jeysulmere and the other States beyond the Thurr. Indeed with a fertile soil, an ample supply of water, and a navigable stream, there cannot be a doubt that the valley of the Narra would soon become as productive as it is now useless, and that its population would become as large and prosperous as it is now scanty and indigent.

(Signed) J. G. FIFE, Lieutenant,  
On Special duty.

*Kurrachee, 16th September 1852.*

P. S.—The information respecting the revenue obtained last season from the lands near the head of the Narra was received from the Collector in Upper Sind, but, owing to a misunderstanding, it was not in an official form, or it would have been attached.

(Signed) J. G. FIFE, Lieutenant, Engineers,  
*Camp Kurrachee, 16th September 1852.* On Special duty.

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## APPENDIX.

No. 1175 of 1852.

REVENUE DEPARTMENT.

From the ACTING COLLECTOR OF HYDERABAD,

To LIEUTENANT FIFE, Executive Engineer on special employ.

SIR,—With reference to former correspondence, I have now the honour to inform you, that the Rubbee crop from the Narra amounted last year to 507 Khurwars, of which I have sold 232 Khurwars, amounting to Rs. 3,343.

2. I have still remaining unsold 275 Khurwars, for which I expect to obtain Rs. 3,660. The whole upturn of the Rubbee crop may therefore be estimated at ..... Rs. 7,000

From the Adhana crop I expect 100 Khurwars will be realised.

From the Tatestanee crop, 50 Khurwars.

From cash rents, 100 Khurwars.

„ fisheries, 600 Khurwars.

Say altogether from grain, cash rent, and fisheries .....Rs. 3,000

Which will show for the year's revenue from the Narra .....Rs. 10,000

3. The Narra has advanced much further this year, and has filled several large dunds near to Kippira, which, last year, its waters did not reach. I therefore expect the amount of revenue obtainable from the Narra this year will be much more considerable than it was last.

I have the honour to be, &c.

(Signed) H. FENNING, Captain,  
Acting Collector.

*Hyderabad, 6th September 1852.*

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No. 1966 OF 1852.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To the COMMISSIONER IN SIND.

SIR,—I have the honour to forward Lieutenant Fife's report and project for a canal to connect the Indus with the Narra River. Lieutenant Fife has informed me of your being most anxious to receive this project for transmission to Government, or I should have preferred allowing it to stand over until Major Turner's return, as he is so much better acquainted with the subject than I am, and moreover my duty just now does not admit of my giving up sufficient time to it; however, being well acquainted with Upper Sind, I may be allowed to state that I think there will be found no difficulty in carrying out the project, while the advantages that will be gained by having a continued supply of water in the Narra cannot at present be estimated.

I have, &c.

(Signed) J. HILL, Captain,  
Offg. Superintending Engineer, Sind.

*Kurrachee, 4th October 1852.*

No. 2094 of 1852.

PUBLIC WORKS.

To H. B. E. FREERE, Esq.,  
Commissioner in Sind.

SIR,—During my absence in Bombay, Captain Hill, who carried on the current duties of my office, transmitted to you Lieutenant Fife's report on the Eastern Narra, and expressed his approval of it ; but under the impression that Government will require my opinion likewise, it will, I think, save a reference if I offer it at once.

2. When Lieutenant Fife was first called upon to direct his attention to the present state of the Narra and to consider the best means of restoring to it a supply of water, its origin, its source, and the cause of its having become dry were unknown ; and both the amount of revenue it formerly yielded, as well as its capabilities, if re-supplied with water, for again fertilizing the lands on its banks, were subjects of the most conflicting opinions. Various officers had reported on it, but the only information of any real value as regards the present inquiry is a very able paper by Major Baker, of the Bengal Engineers, an officer of very high professional reputation, who, when Superintendent of Canals in Sind, had carefully surveyed and levelled the Narra from Fukeerabad to Tujjul, and the country between the former place and the Indus at Roree. It had been supposed that the Narra had become dry in consequence of a bund said to have been constructed by one of the Meers across its bed. Major Baker expressed his disbelief in the existence of any such work, but did not actually disprove it ; while Captain Rathborne, the Collector of Hyderabad, whose sources of information were superior to those of almost any other person in Sind, was very positive that such a bund did exist, and urged very strongly its removal. On one point only all accounts agreed, viz. that at some remote period the Narra was regularly filled, that its waters reached from Upper Sind to Luckput Bunder on the borders of the Runn of Cutch, and that the valley was then highly cultivated and yielded a large revenue.

3. The first question, then, that required to be set at rest, was, did a bund really exist, the removal of which would at once restore water to the Narra ; and if not, why had it become dry ? During the inundation of 1851, Lieutenant Fife, accompanied by a person who declared to the Collector of Hyderabad that he knew the position of the bund and could point it out, examined the head of the Narra, and in a former report Lieutenant Fife clearly proved that no such bund existed, but that the supply of water to the Narra had diminished from natural causes. Major Baker thought it probable that the Narra had once been a branch of the Indus, when the latter, many ages ago, held a course close to the ancient city of Arore ; but if so, the cross sections of the country prove that since that period the whole face of the country must have altered. In the 2nd paragraph of Major Baker's report, he states—"It has been

observed of all large rivers, and has been particularly mentioned by the Geologist Lyell, that the silt with which their waters are charged is deposited during the season of overflow most abundantly near the edge of the stream, and in a proportionally smaller quantity at a greater distance from it. It thus forms a natural glacis, the crest of which is on the river bank, and the slope falls away gradually towards the boundary of the valley. That the Indus is not an exception to this rule will be seen on reference to the cross section." If then the Narra had, during any recent period, been a bed of the Indus, we should expect to find that its banks, like those of the Indus itself, are the highest points in the cross section of the country, whereas for many miles from its head the contrary is the case, the country sloping down towards the banks of the river instead of descending from them. This principle, on which the banks of all alluvial rivers are formed, accounts for the cessation of the supply of water to the Narra. The supply was derived from the overflow of the Indus between Subzulcote and Roree, and as that overflow gradually raised the bank by the deposit of the silt, the extent of the inundation diminished, until of late years it has been very trifling, except in seasons when the rise of the river has been excessive, once perhaps in about twenty years. Thus we find that the Indus water, which, when it leaves the Indus, is quite muddy, by the time it reaches the Narra has become clear, all the silt having been deposited in the intermediate country.

4. In the report now before you, Lieutenant Fife gives an account of his subsequent examination of the Narra and of the country through which the supply channel must pass; and I am sure you will agree with me that the professional ability and great industry displayed in it are very creditable to that officer. In a single season Lieutenant Fife has examined the whole of the Narra, from its sources to where it joins the Pooraun below Wanga Bazar, a distance of nearly 300 miles, besides making various cross sections: he has also gathered a great deal of very interesting and valuable information, and, during the same season, with Lieutenant Pitman's assistance, has very carefully surveyed and levelled three separate lines for feeding channels, enabling him to select and decide with certainty the most eligible line for the supply channel.

5. When the weather in Upper Sind became too hot for out-of-door work Lieutenant Fife came to Kurrachee, and has since employed himself in plotting his surveys and preparing his report. I have thus had frequent opportunities of conferring with him on the subject, and as his report is very full and clear, I need do little more than express my full concurrence both in his reasoning and opinions. Lieutenant Fife has very properly been cautious both in designing his projects and in the expectations he holds out of returns from their being carried out: on the latter point you will be far better able than myself to form an opinion, and, in considering it, I would draw your particular attention to paras. 21 and 22, which show that the extensive cultivation of grain in the valley of the Narra will not have the effect of overstocking the Sind market,

that grain in that locality will be readily purchased by the States beyond the Eastern Desert, and that, if, in addition, the Narra becomes navigable for several months in the year, a considerable portion may be exported *via* Luckput to Cutch.

6. With respect to the three projects, the third, which is estimated at Rs. 4,77,805, and is recommended by Lieutenant Fife, is the one I decidedly prefer; the advantages over the first, in respect to expense and to the increased slope attainable, are very great, and the objections to it appear to me more imaginary than real. The danger of drawing off too much water from the Indus, alluded to by Major Baker, referred to a perennial supply channel, one in which there were to be five feet of water when the Indus was at its lowest; and his view of the question would, I think, most probably have been modified had he completed in detail the project sketched out, as the want of capacity in the Narra, which would have been evident in making calculations for the discharge, very materially affects the flow of water through the supply channel. It is possible that draining the river to this extent when at its lowest, might impede its navigation; but, as Lieutenant Fife proposes to make the bottom of his supply channel at zero, instead of five feet below it, no water whatever will be withdrawn when the river is at its lowest, and at other times the withdrawal of any quantity as proposed, will not, in my opinion, affect the depth of water in the Indus at all. Paradoxical as it may appear, the rise of the river does not always improve its navigable capabilities; for instance, when at Kotree in August last, the river having then risen  $19\frac{1}{2}$  feet above its level in January, a steamer sent down the river was unable to pass a shallow a few miles below Kotree, where there had been no difficulty in passing when the river was low, the sand having risen to even a greater degree than the water.

7. Neither do I think, with the very simple and judicious plan proposed by him for preventing the enlargement of the supply channel, viz. by forcing the stream to pass through rock-cuttings in four separate places, that there is any fear whatever of the Indus forming a passage for itself in that direction. In fact, were danger apprehended, the supply might be cut off altogether.

8. Nor do I see any reason to apprehend that the mouth would silt up, or that it would be masked by a sand-bank. Immediately below the point where Lieutenant Fife proposes to make the cut, the Indus passes through rocky banks, and the velocity of the stream is there tremendous; the river in this place cannot change its course or alter materially the form of its channel, and therefore, though the rock does not extend as high up as the proposed mouth, I believe no sand-bank could exist there, and the slope of the channel itself will be quite sufficient to keep the mouth clear.

9. Again, as the entire supply thrown into the Narra will be less than it must have been when it was annually filled, I can see no danger to be apprehended from flooding the country, but, on the contrary, the greater the quantity of water that is supplied, the nearer will its former prosperity be revived.

10. I also agree with Lieutenant Fife in his reason for not at present making the supply perennial. There is an evident difficulty in rendering the broad irregular channel below Tujjul navigable all the year without interfering with the cultivation on the low lands, where the capacity of the channel becomes so much reduced.

11. With respect to population, scanty though it be in Sind, the experience of the last two years sufficiently shows, that even when the flood is occasional, large tracts are brought under cultivation; once render the supply regular and permanent, and there cannot be a doubt that from Jeysulmere and Cutch people will flock to the Narra, and, as in former times, locate themselves on its banks.

12. You must have observed that the Fualie is gradually silting up, and you know the extent of cultivation dependent on it. The Narra, which passes through the same Collectorate, seems exactly what is wanted to extend cultivation as that of the Fualie decreases.

13. Though the single project designed by Lieutenant Fife for the supply channel will doubtless yield the return he estimates, it will not be complete, nor will it produce more than a fraction of what may be attained without numerous minor subsidiary works, such as bunds, small canals, &c. During the coming season Lieutenant Fife will be employed in carrying on this inquiry, but if, as I trust will be the case, the project be taken up warmly, and an early sanction given to the commencement of the work, he might, if supplied with sufficient assistance, carry on both the excavation of the supply channel and the continuation of the survey simultaneously, and thus save a considerable sum in superintendence.

14. I may add that I have full confidence, that if Lieutenant Fife be entrusted with the work, his rates will be found ample, and the undertaking be completed within the estimated cost.

I have, &c.

(Signed) H. B. TURNER, Major,  
Superintending Engineer, Sind.

*Kurrachee, 21st October 1852.*

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No. 342 of 1852.

From the COMMISSIONER IN SIND,  
To the Right Honorable LORD VISCOUNT FALKLAND,  
Governor and President in Council, Bombay.

MY LORD,—I have the honour to submit a letter from the Officiating  
No. 1966, dated 4th October, Superintending Engineer, transmitting, in original,  
with letter from Lieutenant Fife, No. 55, dated 16th September, reports as per margin, from Lieutenant Fife, on  
the result of the surveys he executed last season

Report by Lieutenant Fife, dated 6th September, with accompanying three Projects.

From Major Turner, Superintending Engineer, No. 2094, dated 21st October.

in the valley of the Eastern Narra, under the sanction conveyed in Mr. Secretary Goldsmid's letter No. 5335, of the 13th May 1851.

2. Feeling assured that your Lordship in Council would wish to have the opinion of Major Turner, who has devoted so much attention to this subject, and whose judgment, on all professional points, is so valuable, I took advantage of his return from Bombay to obtain his opinion in detail on Lieutenant Fife's reports, which will be found among the enclosures.

3. The summary given by Major Turner renders it unnecessary that I should go into any detail regarding the history of the projects for restoring a constant supply of water to the Eastern Narra. He has briefly but clearly stated the extent of Major Baker's inquiries, and the points he left for future examination; the mode in which the subject was revived by Captain Rathborne's suggestions regarding the supposed bund; and the extent and objects of Lieutenant Fife's investigations.

4. Lieutenant Fife's reports, among the enclosures, detail the result of these inquiries. I feel confident your Lordship will concur with Major Turner in the opinion he expresses, that the reports reflect the highest credit on Lieutenant Fife, both as regards the work done and the mode in which its results are detailed. They appear to me to prove beyond question,

5. 1st. That at an expense of Rs. 4,77,805 a quantity of water may be annually, and with certainty, thrown into the Eastern Narra, as great as that which now reaches it only in the extraordinary inundations which take place at intervals of twenty-five years or longer.

6. 2nd. That there is no reason to fear that the obstruction of this quantity of water will in any way affect the supply of water in the Indus lower down.

7. 3rd. That the plan proposed will, in no way, risk a diversion of the main stream into any new channel.

8. 4th. That there exist, within the Hyderabad Collectorate, rich lands capable of being watered from the Eastern Narra to an extent more than commensurate with any possible supply of water.

9. 5th. That there is within reach a sufficient population, able and willing to take advantage of these facilities for cultivation, without permanently withdrawing cultivators from the banks of the Indus.

10. 6th. That a permanent supply of water would probably ensure a permanent population on the Narra, such as evidently, at a remote period, found a living there, but such as has not existed there for several centuries past.

11. 7th. That the return, from simply admitting the water into the old channel, allowing it to flow over the low lands and fill hollows, to be cultivated as they dry up, may, at the lowest, be reckoned at Rs. 52,500 per annum, which is capable of being greatly increased.

12. It will be observed that this is not an hypothetical estimate, but the

result of actual experience, derived from an accidental inundation so high as to produce naturally, in one year, an effect similar to in kind, but smaller in degree, than that which the proposed works will artificially produce every year; and I am satisfied that the estimate is much lower than Lieutenant Fife might safely have assumed.

13. This opinion is grounded, not only on the consideration that the extent of land likely to be irrigated is assumed to be obviously much smaller than might reasonably have been estimated, but on the fact that, by a singular accident, the high inundation of last year has, since Lieutenant Fife commenced his report, been succeeded by one still higher this year, and that we have thus an opportunity of judging of the effect of a repetition of a supply of water, which is still considerably short of that which it is proposed to throw in annually by artificial means.

14. In a report which I have just received from the Collector of Hyderabad, it is stated that the water of the Narra had this year extended much farther south than last season, filling hollows which had been dry for twenty-five years; and that "the produce would be three or four times as great" as it was last season.

15. Now if this result, or anything approaching it, can be obtained by merely letting the water flow where it will, it is clearly not unreasonable to expect that the use of small canals, Persian wheels, and other appliances, such as are universal everywhere else in Sind, will ensure, from an abundant supply of water, and a still more abundant supply of irrigable land, returns equal to what were realised when the Government revenue of the Narra districts was reckoned at more than two and a half laks of Rupees.

16. But, at the very low estimate given by Lieutenant Fife, the direct pecuniary return is so large in proportion to the outlay, that I feel justified in earnestly recommending that the requisite sanction be obtained to the third of Lieutenant Fife's plans (vide his 44th paragraph), as an undertaking calculated to add most materially to the revenue of this large, but, for its extent, hitherto very unproductive district.

17. It would be very desirable if this sanction could be obtained in time sufficient to admit of operations being commenced during the present season; and as the working season may be considered to commence with December, no time is to be lost.

18. In the present report Lieutenant Fife has confined himself to the possibility of restoring a constant annual supply of water to the Narra, and to a calculation of its effects when attained, without further expense or trouble on the part of Government. Pending the receipt of a decision of Government on the propositions now submitted, he purposes examining the vast plains of land in the Hyderabad Collectorate irrigable from the Narra, with a view to determine what portions will make the best return for such supply, and in what manner it can be most economically applied to their irrigation, so as to ensure



the highest possible return for the money laid out. But on this subject he has drawn up a separate report, which was submitted with my letter No. 348, of the 12th instant.

I have the honour to be, &c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind.

*Commissioner's Office, Kurrachee, 9th October 1852.*

No. 7415 of 1852.

TERRITORIAL DEPARTMENT, REVENUE.

From A. MALET, Esq.,

Chief Secretary to Government, Bombay,

To J. P. GRANT, Esq.,

Secretary to the Government of India.

SIR,—I have been directed to transmit herewith, for the purpose of being laid before the Most Noble the Governor General of India in Council, copies of a letter from the Commissioner in Sind, No. 342, dated the 9th ultimo, with enclosures, and to submit the recommendation of the Right Honorable the Governor in Council that the work therein alluded to be sanctioned.

2. The attention of the Government of India is requested by his Lordship in Council to para. 17 of Mr. Frere's letter.

I have the honour to be, &c.

(Signed) A. MALET,

15th November 1852.

Chief Secretary to Government.

*Extract from the Proceedings of the Most Noble the Governor General of India in Council, in the Financial Department, under date the 24th December 1852.*

Read an extract from the proceedings of the Most Noble the Governor General of India in Council, in the Home Department, No. 1016, dated the 7th instant, forwarding, for orders, a despatch from the Government of Bombay, No. 7415, of the 15th ultimo, with enclosures, on the subject of the excavation of a canal to connect the Indus with the Narra river, at a cost of Rs. 4,77,805.

RESOLUTION.—This Government, in the Home Department, observes: "This is a project for a work whereby the Eastern Narra of the Indus will be supplied annually, during the inundation months, with water, which it now only receives in extraordinary floods once in twenty or twenty-five years. From the

enclosure to the foregoing despatch, it appears that the Narra is a side overflow channel, running for about 300 miles in a valley of its own, generally almost desert, but cultivated whenever water enters the Narra from the Indus. It is expected that the revenue immediately realized from the mere overflow of the Narra will pay 11 per cent. on the outlay, and this profit will be largely increased when the usual subsidiary means of cuts, wheels, &c. shall be put in operation, as will be the case whenever the water supply is certain. It appears, further, that the valley of the Narra was formerly regularly cultivated, and gave a revenue of some two laks of rupees. Then the Narra was annually filled, but the supply has been cut off in all but years of very high flood, by the natural rise of the bank of the Indus.

“ Under the orders of the Honorable the Court of Directors, dated the 2nd August 1848, Rs. 50,000 is the general limit to what the Government of India can sanction expenditure for works of the above description ; and the Governor General in Council would not hesitate to authorise an expenditure to that extent for commencing upon this work, pending a reference to the Honorable Court on the subject.”

2. In confirmation of this view of the case, the Most Noble the Governor General in Council is pleased to sanction an expenditure, to the extent of Rs. 50,000, for the purpose of commencing a canal to connect the Narra with the Indus.

ORDER.—Ordered, that a copy of the above Resolution be forwarded to the Home Department for communication to the Government of Bombay, and that the papers noted in the margin be returned to that Department, to enable it to make the reference to the Honorable Court alluded to in the concluding portion of its remarks.

(Signed) J. DORIN,

Secretary to the Government of India.

Letter from the Government of Bombay to the Home Department, No. 7415, of 15th November 1852, and of its enclosures.

No. 188 of 1853.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To the SUPERINTENDING ENGINEER IN SIND.

SIR,—I have the honour to bring to your notice, that of the sum of Rs. 50,000 sanctioned, as per margin, for the formation of a canal from the Indus to the Eastern Narra, Rs. 32,000 have been expended up to this date, leaving a balance of Rs. 18,000 only to carry on the work with.

No. 2818, Extract from the Proceedings of the Most Noble the Governor General of India in Council, in the Territorial Department, under date 24th December 1852.

2. The present rate of expenditure on the work is Rs. 200 per diem ;

though during the month of August, before the sowing of the Rubbee crops had commenced, and which drew off a great number of hands from the works, the daily expenditure was Rs. 400 per diem, and to this it will again rise, probably within a month, or as soon as ever the Khurreef crop has been reaped. After the middle of October, I believe that a very large increase will take place in the number of work-people, as it is then that the weather begins to be most favourable for laborious work like excavation, and that labourers become most abundant.

3. Assuming the average daily expenditure up to the 22nd October at Rs. 300 per day, or for the whole month say ..... Rs. 8,000 and taking that of the ensuing month at Rs. 600 per day, or for

half a month say ..... „ 10,000  
making a total of ..... „ 18,000  
it is evident that the sum of Rs. 18,000 now remaining will only last a month and a half, or up to the 8th November.

4. As the cold season is the time when work of this kind can be most rapidly and most economically carried on, and as the establishment I have organized would, supposing the work were discontinued, have to be discharged, I have to request the favour of your soliciting the sanction of a further sum, to enable me to continue the work until the sanction of the Honorable Court for the whole amount may be obtained.

I have the honour to be, &c.

(Signed) J. G. FIFE, Lieutenant,  
Superintendent, Narra Survey.

*Sukkur, 22nd September 1853.*

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No. 2276 of 1853.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To the COMMISSIONER IN SIND.

SIR,—With reference to your communication No. 273, of the 7th February last, I have the honour to transuit, for your consideration, and with a request that you will bring the subject to the notice of Government, a letter from Lieutenant Fife, representing that unless a further sanction be given his work will be suspended early in November next.

2. I am induced to transmit this letter through you, as you can testify to the great difficulty Lieutenant Fife has encountered in collecting and organizing his work-people, and to the great disadvantage it will be to Government to suspend the work in the cold season, the very time when it can be most expeditiously and economically carried on.

I have the honour to be, &c.

(Signed) H. B. TURNER, Major,  
Superintending Engineer, Sind.

*Kurrachee, 27th September 1853.*

No. 376 of 1853.

TERRITORIAL DEPARTMENT, REVENUE.

From the COMMISSIONER IN SIND,

To the Right Honorable LORD VISCOUNT FALKLAND,

Governor and President in Council, Bombay.

MY LORD,—In submitting the enclosed copy of a letter as per margin, I have the honour to request that, pending the receipt of a reply from the Honorable Court of Directors, the Superintending Engineer may be authorised to push on the excavation of the Narra Canal as fast as possible, so as not to lose the cold season. Very great difficulty has been experienced in collecting labourers, and any interruption now, will delay the opening of the work for a whole year by deferring it over another inundation.

2. All that has transpired since the work commenced, has tended to confirm the opinions originally advanced relative to the immense addition which this work will make to the resources of Sind.

I have the honour to be, &c.

Kurrachee, Commissioner's Office,  
30th September 1853.

(Signed) H. B. F. FRERE,  
Commissioner in Sind.

No. 6141 of 1853.

TERRITORIAL DEPARTMENT, REVENUE.

To the COMMISSIONER IN SIND.

(Resolution of Government, dated the 19th October 1853.)

The work may be continued as proposed, pending result of a further application, which should be made forthwith, to the Government of India, with reference to their Resolution, of which a copy accompanied Mr. Under-Secretary Young's Memorandum No. 17, dated the 12th January 1853.

No. 6142 of 1853.

TERRITORIAL DEPARTMENT, REVENUE.

From A. MALET, Esq.,

Chief Secretary to the Government of Bombay,

To A. R. YOUNG, Esq.,

Under-Secretary to the Government of India.

SIR,—With reference to the Resolution of the Government of India, of which

Letter from the Commissioner in Sind, No. 376, of 30th September 1853, with accompaniments.

Government Resolution, No. 6141, dated 19th Oct. 1853.

a copy accompanied your Memorandum No. 17, dated the 12th January last, I am directed to annex a transcript of the papers noted in the margin, and to request that an additional expenditure may be sanctioned, to enable Lieutenant Fife to continue the excavation of the Narra Canal in Sind.

I have the honour to be, &c.

(Signed) A. MALET,  
Chief Secretary.

*Bombay Castle, 19th October 1853.*

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No. 209 of 1853.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To the SUPERINTENDING ENGINEER IN SIND.

SIR,—I have the honour to submit a report, with map, plans, and estimates, being the result of the survey undertaken during the last cold season.

2. On the whole, the survey has proved very satisfactory. The levelling could scarcely have been surpassed; the errors, with two exceptions, amounting only to an inch. In the cases excepted, the errors were 6 inches and 3 inches, the distances in which they occurred being each about 40 miles.

3. The map, which has been protracted with great care and clearness by Lieutenant Soady, contains the most ample information, not only respecting the levels of the lands, but also as to the extent and height of the flood of 1852. Without this information, it would have been impossible to have designed works with any chance of success. It would have been feasible enough to have merely stopped many of the dund-feeding channels, but, without the levels of the country and the falls of the various branches, the more extensive plan of confining the water to channels which are known to be fruitful sources of revenue would have been almost impossible.

4. As soon as I have completed a portion of the rock-cutting in the supply channel at Rorec, as well as the marking out of the exact line for the channel the whole way to the Narra, I purpose leaving Lieutenant Soady to superintend the work and proceeding to Bukkar and Syed-ka-Gote to obtain the data yet wanting for the bunds at those places; afterwards I shall submit the estimate for those works.

5. If Government will only sanction immediately even a portion of the estimate now submitted, say that for the three first works, the estimates for which amount to Rs. 6,989, I could commence work when I proceed to Bukkar, and, in this way, the season would be saved. I speak of the season, as it is only between October and June that works on the Narra can be carried on, in consequence of the floods to which it is liable, and which would utterly

destroy any works we might have in progress. •I am extremely anxious to have those works completed without delay, as I feel satisfied, after the most mature consideration, that when the wastage of the water is prevented in the manner proposed, we shall have the country under cultivation from Mittrow to Wanga Bazar, and instead of the revenue arising from an occasional natural flood, such as occasioned in 1852, amounting to Rs. 20,000, Government would realize upwards of a lak. Indeed, the cost of the works would be far more than covered in a single season. For the proof of this statement, I must appeal to the facts represented in the report.

I have the honour to be, &c.

(Signed) J. G. FIRE, Lieutenant,  
Superintendent, Narra Survey.

*Sukkur, 31st October 1853.*

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*Report on the Eastern Narra from Togacha to Kippa in the Hyderabad Collectorate, detailing the results of a Survey undertaken with the view of deciding the best means of economising the expenditure of Water and increasing the Revenue as far as practicable.*

1. The dunds which form so striking a feature in the accompanying map of the country between Togacha and Kippa surveyed during the past season, were mentioned in the report of last year on the Narra as being so much below the river, that until they were filled the river made but little onward progress; and in a subsequent part of the same report their value in respect to revenue was stated to be considerable. Their effect on the river, and their value, have, however, now been more precisely obtained by means of the survey and a careful examination of the accounts of the revenue yielded during the past two seasons from the Narra lands which have been watered by extraordinary floods from the Indus.

2. The quantity of water contained by the dunds, when they were surveyed during the cold season, has been calculated from their areas and by means of soundings taken in them. The result of this calculation shows that they contained the enormous quantity of 6,650,000,000 cubic feet. In Colonel Cautley's report on the Ganges Canal, it is assumed as an axiom, that a discharge of one cubic foot per second constant is sufficient for the cultivation of 350 beegahs of land. Now, a discharge of one cubic foot per second constant would give 31,536,000 cubic feet in a year. The quantity of water contained in the dunds would, therefore, have been sufficient for the cultivation of about 74,000 beegahs, which, assessed at the rate of Rs. 1½ per beegah, would have yielded a revenue of Rs. 1,11,000. The revenue actually yielded by the dund lands was for the season 1851-52 Rs. 855, and for the season 1852-53 Rs. 464. It at first seems strange, that, yielding so small an

amount of revenue, the dunds should have ever been so highly thought of by the Natives ; but this is susceptible of explanation. The Narra's natural supply of water is precarious ; the dunds are capacious, for, years after being filled by a flood, they would continue to yield grain and fish in quantities not large perhaps considering the extent of country, but large enough to feed and give employment to the people. When the supply of water in the Narra failed, the dunds still continued to yield. The revenue obtained during any one season was perhaps never great, though that arising during many seasons from the effect of one flood may have been considerable. But it could scarcely, under even the most favourable circumstances, have been proportionate to the quantity of water used. It therefore appears that so long as there is need of water elsewhere, it would not be advisable to supply the dunds. It will be seen in the following pages, that while the works proposed for cutting off the dunds from the river are calculated to completely exclude the water during ordinary floods, during great floods, when there would be a superabundance of water, the most extensive and valuable of the dunds will receive a supply by the overflowing of the Narra.

3. The revenue obtained from the Narra may be said to arise almost entirely from the cultivation on the plain, where overflows take place, and in the bed of the river from below Bukkar. The first overflow takes place from the extensive swamp south-east of Mittrow. The lands immediately to the south of the swamp are, as will be seen by a reference to the levels on the map, extremely low, and during the flood of 1852 the water extended to the village of Sangah, and escaped thence across the plain to Joon and Sirenwarree. A second overflow takes place immediately above Choteearree : a third (and one which, when the works hereafter proposed are carried out, will produce a large revenue) occurs near the village of Kharee. The water from this overflow, after traversing a fertile plain for many miles, returns to the Narra below Kippira. From Kippira the banks of the Narra continue low the whole way to Wanga Bazar, a distance of 100 miles. The revenue obtained from the plain, and from the river bed as far as Sirenwarree, during the season 1851-52, amounted to Rs. 6,240, and this was principally obtained from the lands near Sangah and Bukkar. The revenue obtained during the succeeding season of 1852-53, from the same lands, with the addition of those near Kharee, was something over Rs. 19,000, the lands near Sangah and Bukkar being again very productive. From these facts, the great advantage that will result from the works detailed in the following paragraphs will be sufficiently clear, especially when it is considered that where the land is generally good, the overflowing of the stream does not waste the water, for what is not absorbed by the land returns to the river, to be again useful in other places.

4. The first work for effecting the object in view is the bund at the head of the branch called the Adhwana, which leaves the Narra opposite Togacha, and, after traversing a sandy plain for a distance of eleven miles and throwing off

numerous feeding channels which supply the dunds from Togacha to Ubrow, rejoins the main stream above Puttaee. This work will cut off sixteen of the dunds, as well as prevent the wastage of water in an irregular sandy channel. The details of the bund are shown in Sheet No. 1. The peculiarity of its construction is, that it will be formed of loose sand, the only material which the spot furnishes. To make up for the inferiority of the material, the mass is increased far beyond the ordinary dimensions when a better material is employed. The site in every other respect is an extremely good one; it lies between two high sand-hills, and, extending both up and down the Narra from them, are ranges of smaller hills, which render the escape of the water from the Narra at any other point on the east bank impossible. The bund will be six feet above the flood level of 1852; an allowance of one foot being made for the increase in the height of the Narra due to the escape of the water down the Adhwana being cut off, and five feet being allowed for the settlement of the material and for any extraordinary flood which may occur. As, however, during even ordinary floods the plain on the west bank is overflowed, no very great increase in the height of the floods need be apprehended. The estimate for this work amounts to Rs. 1,442.

5. The second work is the bund across the main channel of the Narra near the head of the branch called the Owwud. The main channel from this point runs in a south-easterly direction through a sandy tract as far as Bukkar, throwing off numerous feeders to the dunds, and in one place below Shaikhana flowing through them. The branch called the Owwud has a regular channel, from 300 to 400 feet wide, and is about seven feet deep. It has a fall of nearly two feet per mile as far as Mittrow, where it escapes on to the plain. It is this branch which causes the extensive overflowing of the plain towards Sangah and Bukkar, and which therefore is such a fruitful source of revenue. The bund across the Narra will effect the double purpose of cutting off the dunds below Ubrow, and, by causing a larger body of water to pass down the Owwud, increasing the overflow of the plain towards Sangah. The details of the bund will be found in Sheet No. 2. Like that at the head of the Adhwana, it will be constructed of loose sand, the only material procurable within a reasonable distance. The position of the work in other respects is favourable. It is close to the spot where the Owwud and Narra separate, though not so close as to be affected by the stream in the former. Both banks of the Narra are above flood level. The bund will be seven feet above the flood level of 1852. An allowance of two feet is due to the increase in height to which the water will rise from its escape down the Adhwana and Narra being prevented. This allowance may appear small considering the size of the channels cut off, but, as in the case of the Narra opposite the head of the Adhwana, the west bank of the Owwud during even ordinary floods is inundated, and perhaps as much water finds its way to Mittrow by passing over the plain as is conveyed there through the channel of the Owwud. A part of the excess of water arising from



the construction of the bunds at the head of the Owwud and across the main channel of the Narra will be carried off by the Jukrow branch. The remaining five feet of height to the bund are allowed for the settlement of the material and for any extraordinary flood. The estimate for this work amounts to Rs. 4,085.

6. The next works which come under consideration are the bund across the Owwud at Chundrajee, a bund in an opening in the sand-hills near Sabrajee, a bund across the Narra above Bukkar, and a canal from the extensive swamp near Vuchoo to the Narra at Bukkar. The object of the three first works, viz. the bunds, is to prevent all return of the water of the Owwud to the Narra above Bukkar, either through the channel at Chundrajee, through the opening in the sand-hills near Sabrajee, or by means of the channel of the Narra itself at Bukkar. The object of the canal is a twofold one; first, to enable boats to cross from the swamp to Bukkar, between which points, except during considerable floods, the depth of water on the plain would be insufficient; and secondly, to drain the swamp when the river subsides in September, and enable the people to cultivate the land.

7. The bund across the Owwud at Chundrajee is shown in Sheet No. 3. It will be constructed of soil. The site is a very favourable one; both banks are above flood level, and good material for the bund can be had close to the site. The top of the bund will be seven feet above the flood level of 1852. An allowance of three feet is made for the increase in height which the water will attain from being prevented escaping in any direction except the south till it reaches Bukkar: the remaining four feet are allowed for the settlement of the material and for any extraordinary flood. An inspection of the levels on the map will show that the escape of the water southwards during a high flood would be sufficiently rapid to prevent its attaining any extraordinary height at Chundrajee. The bunds at Sabrajee and Bukkar were not contemplated at the time the survey was made, and the requisite data, viz. sections of the opening in the sand-hills and of the Narra at Bukkar, have yet to be obtained before the works can be designed. In the first case, there is merely an opening a few hundred feet in width to be stopped, the head of water to contend with being trifling. In the second case, however, there is a large channel to stop, the head of water amounting to about fourteen feet; but there is good material at hand. The estimate for the Chundrajee Bund amounts to Rs. 1,462.

8. The course of the canal from the swamps to Bukkar is shown on the map by the strong red line, and the detail is given in Sheet No. 4. The length is four and a half miles. Its bed commences with an initial depth of four feet below the level of the water in the swamp, and is carried to the river at Bukkar with an uniform fall of one foot per mile. The canal is twenty feet wide at bottom, with slopes of  $1\frac{1}{2}$  to 1. There would, during eight months in the year, be from five to nine feet of water in it. As a portion of the line was not levelled, the levels at various points in some lines of levels taken near the place have been assumed to represent the elevation of the land at parallel

points along the line of the canal. This is not an accurate plan, but the slope of the country is so regular that no material error can arise. The estimate for this work amounts to Rs. 6,884.

9. Below Bukkar the works at the entrance of the Bund and Drubbree Dunds below Choteearee occur next in succession, though the Nongnee and Punneehull Dunds are both sometimes filled by water which escapes from the Narra above Choteearee; this only happens when the Narra, in that locality a very large channel, overflows its banks. Connecting the Bund Dund with the Narra are four feeding channels, one being large and deep, the other three small and shallow. The bunds for these channels are shown in Sheet No. 5. They will all be constructed of soil. The sites for the two first lie between high banks not subject to inundation: the sites for the other two are not favourable, the banks being subject to inundation during the high floods. The bunds may be turned and carried away during a high flood, but as the loss of the water which would escape through the two small channels under such circumstances would not be felt, the only loss entailed would be the cost of re-constructing them, and their original cost is estimated at Rs. 585 only. The whole of the bunds will be raised five feet above the flood level of 1852; one foot being allowed for the increase in height to which the water will rise consequent on its escape towards the dunds being prevented, and four feet for the settlement of the material and for any extraordinary flood. The four bunds are estimated to cost Rs. 2,784.

10. Connected during floods with the Jooreearee Dund is the Sarajee Dund, which, however, also receives a supply through two feeding channels which leave the Narra above Mitta Khan-ke-Tanda. The sites for the bunds in these channels lie between high banks. Soil will be used for the construction of both bunds. The details are given in Sheet No. 6. Like those mentioned in the preceding paragraph, they will be raised five feet above the flood level of 1852, and for the same reasons. These bunds, in connection with the four previously described, will, when there is an ordinary supply of water in the river, exclude it from thirteen dunds. During high floods the water will pass across the plain from Choteearee and escape into the Sangidiarah Dund, and thence into all the rest. The two bunds to the Sarajee Dund are estimated at Rs. 2,470.

11. The Thurr Narra, which leaves the main channel about two miles above Sirenwarree and joins it again below Khetee, is the next portion of the river requiring works for its improvement. This channel enters the Thurr immediately after leaving the main channel, and, after running for a distance of twenty-two miles, sometimes feeding and sometimes actually running through a perfect maze of extensive dunds, returns to the plain again at Khetee. For the purpose of preventing the escape of the water through the Thurr Narra, two large bunds are necessary; one at the head of the channel two miles above Sirenwarree, the other where it emerges from the Thurr at Khetee. They are

shown in Sheet No. 7. Water also finds its way across the plain to the dunds from a point a little below Kharee, but only when the Narra overflows its banks. The sites chosen for the bunds both lie between high banks not subject to inundation, and soil can be procured for both works. The upper bund will be raised six feet above the flood level of 1852, two feet being allowed for the rise in the level of the river, owing to the escape of the water towards the Thurr being prevented, and four feet for the settlement of the material and for any extraordinary flood. The lower bund will be raised seven feet above the flood level of 1852. In this case no increase to the head of water would be caused by the bund, as it would merely prevent the escape of a back-water; but the flood of 1852 was checked before it reached Khetee in consequence of an immense body of water being absorbed by the dunds above that place. An allowance of three feet is therefore made for the height to which the flood would have risen had the escape of the water into the dunds been prevented. This assumed level for the flood is 35.63 below the zero of the levels shown on the map, and a reference to the latter will show that were the flood to attain that height, it would flood the plain the whole way across to the village of Driggal, about fourteen miles to the west of Khetee. As there is nothing to prevent the escape south of such a flood, the allowance of three feet would appear sufficient: the remaining four feet are allowed for the settlement of the material and for any extraordinary flood. These two bunds are estimated to cost Rs. 6,448.

12. The prevention of the escape of the water into the Rarr Dund, and two others connected with it, will be easily effected. The channel connecting them with the river is a small one, and the head of water inconsiderable. The bund is shown in Sheet No. 8. The site is a favourable one, both from the high banks between which it lies, and from good material being close at hand. The bund will be raised seven feet above the flood level of 1852, three feet being allowed for the height to which the water would have risen had its escape into the dunds been prevented. The cost is estimated at Rs. 628.

13. South of the Rarr Dund there are only nineteen dunds requiring four bunds to exclude the water. There was not leisure during the last season to extend the survey to these, and the data for the bunds has yet to be obtained.

## PART II.

14. In the preceding paragraphs those works only have been described for which there is absolute necessity. Insignificant as some of them may appear, they are of vital importance not only to the project for furnishing the Narra with a regular stream, but even for doing justice to the Narra in its present state with its very uncertain supply. The result of the survey has, however, suggested another work, which, for the purposes of irrigation, would perhaps surpass any work in the country. This work is a canal commencing at the bed of the Owwud, on the north side of the swamp below Mittrow, and running in

a southerly direction the whole way to Wanga Bazar, a distance of nearly 120 miles.

15. The course of the canal is indicated on the map by the strong red dotted line. It would leave the Owwud about three miles below Mittrow, and would run thence in a south-easterly direction to a point about ten miles east of Meerpoor, and afterwards run direct on to the channel of the Pooraun above Wanga Bazar. Supposing it to commence with an initial depth of two feet below the level of the water in the swamp, and to be carried south with an uniform slope of nine inches per mile, the depth of cutting after entering the high ground at Dhora would be about eight feet, and the water would, with a rise of six feet above its lowest level, be just flush with the ground. The plain having a regular slope from the north-west, a strip of land about two miles in width on the west bank, and one five miles in width, or to where the influence of the Narra floods ceased on the east bank of the canal, could be cultivated. The canal would also be highly useful as a navigable channel.

16. The peculiar advantages of this canal would, for the purposes of irrigation, be the certainty of its supply of water; the long period, about eight months in the year, during which it would run; and the moderate depth of the excavation. The first two advantages would arise from the bed of the canal being below the lowest level of the water in the Owwud, and from the difference between the lowest level and flood level being only six feet, the difference of level in the Indus varying from thirteen feet in Upper to eighteen in Lower Sind. The third advantage would arise from the level at which the canal receives its supply being high with reference to the lands to be irrigated.

17. The cultivation carried on near the Narra itself will consist of the Rubbee and Adawah crops, on lands submerged from June to the month of September, the period during which the Khurreef crop is cultivated. The cultivation carried on by means of the canal would be almost entirely Khurreef. The latter would, therefore, give employment to the Narra population at a time when the cultivation near the river would be necessarily suspended.

18. This work occupying an intermediate position between the Narra and the lands watered by the Indus canals, would reclaim an extensive tract, which, from the traces of irrigating channels and numbers of tombs met with, was probably once in a highly cultivated state, but which, from the Indus canals failing, has been gradually deserted. It was probably to this tract that Major Baker referred in the 17th paragraph of his report on the Narra.

19. The quantity of land which may, with the aid of the works detailed in the first part of this Report, be cultivated near the Narra is so great, and the permanent population there at present so small, that it would perhaps be premature to undertake so extensive a work as the canal at present, unless it should be considered that the people already residing at Sunjoora, Polliadee, Meerpoor, Joorah, Shah-Syed, and other places near its course, are sufficiently numerous to cultivate the lands to an extent great enough to afford an adequate

return on the outlay. In an engineering point of view, the canal would be an admirable work; but I have no means of answering the question as to whether it would be profitable to carry out the project at present.

(Signed) J. G. FIFE, Lieutenant,  
Superintendent, Narra Survey.

Sukkur, 31st October 1853.

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No. 1 of 1853.

PUBLIC WORKS.

REVENUE DEPARTMENT.

*Estimate framed by Lieutenant J. G. Fife, Superintendent Narra Survey, of the probable Expense of constructing Bunds across various branches of the Eastern Narra, and across some of the feeding channels to Dunds between Togacha and Kippira, in order to prevent the Water from being wasted where the land is valueless or where not required in the Dunds, and to increase as far as practicable its overflow where the soil is well adapted for cultivation. (Estimate prepared agreeably to instructions accompanying letter No. 1909, dated 29th December 1851, from the Superintending Engineer in Sind.)*

SUKKUR, 31st October 1853.

*General Description.*—The bunds, with two exceptions, viz. that across the head of the Adhwana near Togacha, and that across the Narra near the head of the Owwud, to be constructed of well rammed earth. The front and rear slopes to be 1 in 4 and 1 in 2 respectively. The top of the bunds being raised to a height of four feet above the highest probable flood level. The bunds to have an increase of width at top of three feet per every foot of water they have to sustain, the minimum width at top being restricted to ten feet. The front slopes, wherever the bunds may occupy exposed situations, to be defended from the action of the waves by strong jow matting, securely picketed down to the slope. The bunds across the Adhwana near Togacha, and the Narra near the head of the Owwud, to be constructed of sand; no other material being procurable. The front and rear slopes to be both 1 in 4. The top of the bunds to be raised five feet above the highest probable flood level. The bunds to have an increase in width at top of eleven feet per every foot of water they have to sustain, the minimum width being restricted to fifteen feet. The sand most favourable to vegetation, or what might not improperly be called soily sand, to be laid on last, in order to defend the loose sand below from the action of the wind, and which it will effectually do when the grass springs up. The bund to be watered and sown down with grass or Tamarisk seed, whichever may be easiest procured.

*Bund at the head of the Adhwana opposite the Village of Togacha.*—This bund is shown in Sheet No. 1. By its construction the water from the Narra will be prevented from escaping down a large sandy channel, along the banks of which the soil is quite unsuited for any kind of cultivation, at the same time that by this single work the whole of the profitless dunds from Togacha to Ubrow will be cut off. The site of the bund is about 500 feet from the Narra, and lies between two high sand-hills, rendering the work perfectly secure from being turned during high floods. The total length of the bund is 582 feet, its maximum width at top being 81 feet. The head of water to be sustained where these dimensions occur is seven feet. Nearly the whole of the material used will be taken from the high sand-hills on either bank. The soil, only for a covering to the loose sand, will be procured from a distance. The front slope, from a point five feet above the flood line to fifteen feet below it, to be defended from the ripple by jow matting.

*Measurements.*

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>SAND-WORK.</b>						
1st portion (south bank) .. .. .	..	15	35½	5	2,643½	
2nd " " .. .. .	..	25	43	6½	6,987½	
3rd " " .. .. .	..	30	59½	7½	13,387½	
4th " " .. .. .	..	50	69	8	27,600	
5th " " .. .. .	..	14	97	10	13,580	
6th " " .. .. .	..	42	129	12	65,016	
7th " " .. .. .	..	76	112	11	93,632	
8th " " .. .. .	..	88	104	10	91,520	
9th " " .. .. .	..	54	121	11½	75,141	
10th " " .. .. .	..	69	101	10	69,690	
11th " " .. .. .	..	119	50	6	35,700	
Total solid feet .	..	..	..	..	..	4,24,897½
Deduct—						
For upper coating of soil.						
For top of Bund .. .. .	..	582	45	½	13,095	
" Slopes .. .. .	2	582	34	½	19,768	
Total deduction .	..	..	..	..	..	32,863
Total solid feet of sand-work..	..	..	..	..	..	4,62,034½
<b>MATTING.</b>						
For 20 feet of front slope of bund, at 8 annas per 100 square feet .. .. .	..	582	20	..	11,640	
Total square feet .	..	..	..	..	..	11,640

<i>Abstract.</i>		<i>Rs. a. p.</i>		
4,62,034½	solid feet raising bund with sand, at Rs. 2 per 1,000 solid feet.....	924	1	1
32,863	solid feet coating bund with soil and watering, at Rs. 10 per 1,000 solid feet.....	328	10	0
11,640	square feet of jow matting, at 8 annas per 100 square feet.....	58	3	2
		1,310	14	3
Contingencies and extra establishment, 10 per cent .		131	1	3
Total amount for bund at head of Adhwana .....		1,442	0	0

*Bund across the Narra near the Head of the Oowud.*—This bund is shown in Sheet No. 2. The object of this bund is to turn the whole of the water down the branch called the Oowud, which runs past the village of Mittrow and fertilizes the plain south and east of that place, and at the same time cut off the water from the sandy channel of the Narra and the whole of the dunds from Ubrow to Chundrajee. The site of the bund is about 200 feet below the point where the two streams separate, and lies between high banks not subject to inundation. The Narra at this point has one central main channel and two offshoots. The total length of the bund is 1,230 feet. Its maximum width at top is 108 feet, at base 244 feet, and its height is 14½ feet, the head of water to be sustained being 9½ feet. The material (sand) used will be taken partly from the high banks and partly from the bed of the channel in front of the work. The soil for covering the loose sand will be brought from a distance. Twenty feet of the front slope to be defended from the ripple with jow matting; the matting to commence at a point five feet above flood line.

#### *Measurements.*

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>SAND-WORK.</b>						
1st portion of offshoot on west side of Narra .....	1	10	100½	5½	5,527½	
2nd " " " .....	..	177	99½	10	1,76,115	
3rd " " " .....	..	53	45	4½	10,732½	
1st portion of main channel....	..	10	106	6½	6,625	
2nd " " " .....	..	22	151	13½	44,847	
3rd " " " .....	..	85	151	13½	1,73,272½	
4th " " " .....	..	146	115½	11	1,85,493	
5th " " " .....	..	147	82	9	1,08,486	
6th " " " .....	..	70	76½	8½	45,517½	
7th " " " .....	..	80	99	10	79,200	
8th " " " .....	..	15	84	9	11,340	
Carried over .	..	..	..	..	8,47,156	

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>SAND-WORK, <i>contd.</i></b>						
Brought over..	..	..	..	..	8,47,156	
9th portion of main channel....	..	7	44½	6	1,869	
1st portion of eastern offshoot..	..	38	44½	6	10,146	
2nd „ „ ..	..	20	86	9	15,480	
3rd „ „ ..	..	282	86	9	2,18,268	
4th „ „ ..	..	58	54	7	21,924	
5th „ „ ..	..	10	34½	3½	1,207½	
Total solid feet..	..	..	..	..	....	11,16,050½
Deduct—						
For upper coating of soil.						
For top of bund .....	..	1230	49	½	30,135	
„ slopes.....	2	1230	34	½	41,820	
Total deduction..	..	..	..	..	....	71,955
Total solid feet of sand-work ..	..	..	..	..	....	10,44,095½
<b>MATTING.</b>						
For 20 feet of front slope of bund..	..	1230	20	..	24,600	
Total square feet for matting..	..	..	..	..	....	24,600

*Abstract.**Rs. a. p.*

10,44,095½ solid feet raising bund with sand, at Rs. 2-12-0 per 1,000 solid feet .....	2,871	4	2
71,955 solid feet coating bund with soil and watering, at Rs. 10 per 1,000 solid feet .....	719	8	9
24,600 square feet of jow matting, at annas 8 per 100 square feet. ....	123	0	0
	3,713	12	11
Contingencies and extra establishment, at 10 per cent. ....	371	6	1
Total amount for bund across the Narra near the head of the Owwud .....	4,085	0	0

*Bund across the Owwud at the Village of Chundrajee.*—This bund is shown in Sheet No. 3. By the construction of this bund the water which would escape from the plain into the Narra near Chundrajee will be saved, and made to fertilize the land as far as Bukkar, where the channel of the Narra lies through soil, and is well adapted for conveying water without waste. During high floods this work would have the effect of making a large body of water pass from Dhora southwards over the plain, which consists of extremely good soil. The



site for the work lies between a sand-hill and a high clay-bank, neither of which are subject to inundation. The total length of the bund is 581 feet. Its maximum width at top is 47 feet, at base 165 feet, and its height is  $19\frac{3}{4}$  feet, the head of water to be sustained being  $15\frac{3}{4}$  feet. The material used (soil) to be taken partly from the bed of the channel in front of the work, and partly from the north bank. Twenty feet of the fore slope of the bund, where it crosses the deepest part of the channel, to be defended from the action of the waves by strong jow mats firmly picketed down. Within this twenty feet will be comprised the supposed level which the water will obtain, as well as the last year's flood level. Matting is not required in the shallow part of the channel, as the jungle there will effectually break the waves.

*Measurements.*

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>EARTH-WORK.</b>						
1st portion (south bank) .....	..	18	45	$3\frac{1}{2}$	2,632 $\frac{1}{2}$	
2nd " " .....	..	23	$76\frac{1}{2}$	$12\frac{1}{2}$	21,993 $\frac{1}{2}$	
3rd " " .....	..	103	104	$18\frac{1}{2}$	1,98,172	
4th " " .....	..	37	$106\frac{1}{2}$	$19\frac{1}{2}$	77,642	
5th " " .....	..	35	78	15	40,950	
6th " " .....	..	117	47	10	54,990	
7th " " .....	..	189	54	11	1,12,266	
8th " " .....	..	27	47	$9\frac{3}{4}$	12,372 $\frac{3}{4}$	
9th " " .....	..	32	$20\frac{1}{2}$	$3\frac{1}{2}$	2,296	
Total solid feet. .	..	..	..	..	....	5,23,315
<b>MATTING.</b>						
For 20 feet of the front slope in the deep part of the channel ..	..	216	20	..	4,320	
Total square feet. .	..	..	..	..	....	4,320

*Abstract.*

*Rs. a. p.*

5,23,314 solid feet raising and ramming bund with clay, at Rs. 2-8-0			
per 1,000 solid feet .....	1,308	4	7
4,320 square feet of jow matting to front slope, at 8 annas per 100 square feet .....	21	9	7
	1,329	14	2
Contingencies and extra establishment, at 10 per cent. . .	132	15	9
Total amount for bund across the Owwud at Chundrajee. .	1,462	0	0

*Bunds across the four Feeding Channels to the " Bund Dund " below Chotee-aree.*—These bunds are shown in Sheet No. 5. Their object is to prevent a vast quantity of water from escaping from the river into the Bund Dund, and thence into numerous other large dunds extending many miles into the Desert or Thurr. The sites for the two largest bunds lie between high banks, not subject to inundation. The sites of the smaller bunds lie between high banks, but which are submerged during great floods. The two smaller bunds will therefore perhaps need renewing after large floods. Their cost is, however, small. The bunds are respectively 575, 192, 270, and 163 feet long; their maximum heights being 21, 18½, 15½, and 14½ feet; thickness at top 56, 44, 35, and 34 feet; and the heads of water to be sustained are 17, 14½, 11½, and 10½ feet. The material (soil) will be taken from the bed of the dund and from the bed and bank of the Narra.

*Measurements.*

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>1ST BUND.</b>						
1st portion (south bank) . . . .	..	25	17½	2½	1,09,375	
2nd " " " " " " " " " " " "	..	45	56	10½	27,090	
3rd " " " " " " " " " " " "	..	42	93	17½	68,355	
4th " " " " " " " " " " " "	..	42	104½	19	83,391	
5th " " " " " " " " " " " "	..	42	114½	20½	97,382½	
6th " " " " " " " " " " " "	..	42	103	18½	81,112½	
7th " " " " " " " " " " " "	..	56	66	13	48,048	
8th " " " " " " " " " " " "	..	77	60	12	55,440	
9th " " " " " " " " " " " "	..	95	66	13	81,510	
10th " " " " " " " " " " " "	..	94	41	8½	31,795½	
11th " " " " " " " " " " " "	..	15	17½	2½	656½	
Total solid feet for 1st Bund. . . .	..	..	..	..	..	5,75,874½
<b>2ND BUND.</b>					Square feet.	Square feet.
1st portion (south bank) . . . .	..	20	17½	2½	875	
2nd " " " " " " " " " " " "	..	50	56	10½	30,100	
3rd " " " " " " " " " " " "	..	46	93½	17½	75,267½	
4th " " " " " " " " " " " "	..	57	93½	17½	93,266½	
5th " " " " " " " " " " " "	..	39	56	10½	23,478	
6th " " " " " " " " " " " "	..	18	17½	2½	787½	
Total solid feet for 2nd Bund. . . .	..	..	..	..	..	2,23,774½
<b>3RD BUND.</b>						
1st portion (south bank) . . . .	..	34	20	3½	2,380	
2nd " " " " " " " " " " " "	..	63	49½	10	31,185	
3rd " " " " " " " " " " " "	..	70	75½	14½	76,632½	
4th " " " " " " " " " " " "	..	51	59	12	36,108	
5th " " " " " " " " " " " "	..	36	30½	6½	7,137	
6th " " " " " " " " " " " "	..	16	17½	2½	700	
Total solid feet for 3rd Bund. . . .	..	..	..	..	..	1,54,142½

	No.	Length.	Breadth.	Height.	Square feet.	Square feet.
<b>4TH BUND.</b>						
1st portion (south bank) . . . .	..	28	17½	2½	1,225	
2nd   "                 "         . . . .	..	56	49½	9½	26,334	
3rd   "                 "         . . . .	..	19	73¾	14½	19,967¾	
4th   "                 "         . . . .	..	13	71½	13¾	12,780½	
5th   "                 "         . . . .	..	22	50	10½	11,275	
6th   "                 "         . . . .	..	25	20½	3½	1,793½	
Total solid feet for 4th Bund . . .	..	..	..	..	..	73,376

	<i>Abstract.</i>	<i>Rs.</i>	<i>a.</i>	<i>p.</i>
5,75,874½ solid feet raising 1st bund with clay and ramming, at Rs. 2-8-0 per 1,000 solid feet . . . . .		1,439	10	11
2,23,774½ solid feet ditto 2nd bund ditto ditto, at Rs. 2-8-0 per 1,000 solid feet . . . . .		559	6	11
1,54,142½ solid feet ditto 3rd bund ditto ditto, at Rs. 2-8-0 per 1,000 solid feet . . . . .		385	5	8
73,366 solid feet ditto 4th bund ditto ditto, at Rs. 2-0-0 per 1,000 solid feet . . . . .		146	12	0
		2,531	3	6
Contingencies and extra establishment, at 10 per cent . . .		253	1	11
<b>Total amount for bunds in the Bund Dand feeding channels.</b>		<b>2,784</b>	<b>0</b>	<b>0</b>

*Bunds across the two Feeding Channels to the Sarajce Dund.*—These bunds are shown in Sheet No. 6. Their object is to prevent the water escaping from the Narra into the Sarajec and other dunds. The sites for the two bunds lie between high banks not subject to inundation. The bunds are respectively 374 and 341 feet in length; the maximum heights  $21\frac{1}{2}$  and  $18\frac{1}{2}$  feet; width at top  $52\frac{1}{2}$  and  $43\frac{1}{2}$ ; and the heads of water are  $17\frac{1}{2}$  and  $14\frac{1}{2}$  feet. The material (soil) will be taken principally from the ground between the two bunds.

### Measurements.

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>1st BUND.</b>						
1st portion (east bank) . . . .	..	38	17½	2½	1,662½	
2nd " " . . . .	..	80	62	11½	58,280	
3rd " " . . . .	..	79	108	20	1,70,640	
4th " " . . . .	..	79	108	20	1,70,640	
5th " " . . . .	..	68	62	11½	49,538	
6th " " . . . .	..	30	17½	2½	1,312½	
<b>Total solid feet for 1st Bund..</b>	..	..	..	..	....	<b>4,52,073</b>

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>2ND BUND.</b>						
1st portion (south bank) . . . .	..	28	17½	2½	1,225	
2nd " " " " . . . .	..	50	33½	7	11,725	
3rd " " " " . . . .	..	34	67	13	29,614	
4th " " " " . . . .	..	61	95½	18	1,04,859	
5th " " " " . . . .	..	93	95½	18	1,59,867	
6th " " " " . . . .	..	28	81	15½	35,154	
7th " " " " . . . .	..	29	47½	9½	13,086	
8th " " " " . . . .	..	18	17½	2½	787½	
Total solid feet for 2nd Bund. .	..	..	..	..	....	3,56,318

*Abstract.**Rs. a. p.*

4,52,073 solid feet of raising 1st Bund with clay and ramming, at Rs. 3 per 1,000 cubic feet . . . . .	1,356	3	6
3,56,318 solid feet of raising 2nd Bund with clay and ramming, at Rs. 2-8-0 per 1,000 cubic feet. . . . .	890	12	1
	2,247	0	2
Contingencies and extra establishment, at 10 per cent. . . . .	224	11	2
Total amount for bunds in Sarajee Dund feeding channels. . . . .	2,471	0	0

*Bunds across the Thurr Narra above the Village of Sirenwarree and below Khetee.*—These bunds are shown in Sheet No. 7. Their object is to prevent the water escaping by means of the branch called the Thurr Narra into the whole of the extensive dunds between Puttechul and Khetee. The sites for the bunds lie between high banks not subject to inundation. The bund at the head of the branch is 533 feet in length, with a maximum height and thickness at top of 28 and 72 feet, the head of water to be sustained being 24 feet. The bund below Khetee is 651 feet in length, with a maximum height and thickness at top of 21½ and 52½ feet, the head of water to be sustained being 17½ feet. The material for the first bund will be principally taken from the north bank of the channel; that for the Khetee bund will be taken from both banks a little south of the site of the work. The front slope of the bund at the head of the branch to be defended from the action of waves in the deepest part of the channel by strong jow matting firmly picketed down. The matting to extend from a point five feet above flood level to fifteen feet below it. The front slope of the Khetee bund to be defended in the same way the whole way across the channel.

*Measurements.*

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
<b>UPPER BUND.</b>						
1st portion (east bank) . . . . .	..	15	19	3	855	
2nd " " . . . . .	..	54	39 $\frac{1}{4}$	8 $\frac{1}{2}$	17,597 $\frac{1}{4}$	
3rd " " . . . . .	..	29	66 $\frac{1}{4}$	13	24,976 $\frac{1}{4}$	
4th " " . . . . .	..	40	87 $\frac{1}{2}$	16 $\frac{3}{4}$	58,625	
5th " " . . . . .	..	44	79 $\frac{3}{4}$	15 $\frac{1}{2}$	54,389 $\frac{1}{2}$	
6th " " . . . . .	..	16	57	11 $\frac{1}{2}$	1,488	
7th " " . . . . .	..	30	45	9 $\frac{1}{2}$	12,825	
8th " " . . . . .	..	83	66	13	71,214	
9th " " . . . . .	..	35	111	20 $\frac{1}{2}$	79,642 $\frac{1}{2}$	
10th " " . . . . .	..	35	144	26	1,31,040	
11th " " . . . . .	..	35	144	26	1,31,040	
12th " " . . . . .	..	35	111	20 $\frac{1}{2}$	79,642 $\frac{1}{2}$	
13th " " . . . . .	..	64	59	11 $\frac{1}{2}$	43,424	
14th " " . . . . .	..	18	19	3	1,026	
Total solid feet for Upper Bund. . .	..	..	..	..	....	7,07,785
<b>MATTING.</b>						
For 247 feet in length of front slope. . . . .	..	247	20	..	4,940	
Total square feet of jow matting for Upper Bund . . . . .	..	..	..	..	....	4,940

	No.	Length.	Breadth.	Height.	Sold feet.	Solid feet.
<b>LOWER BUND.</b>						
1st portion (east bank) . . . . .	..	27	36 $\frac{1}{2}$	6 $\frac{1}{2}$	6,159 $\frac{1}{2}$	
2nd " " . . . . .	..	50	84 $\frac{1}{2}$	16	67,400	
10th central portion . . . . .	..	500	108	20	10,80,000	
13th portion. . . . .	..	50	77 $\frac{1}{2}$	15	58,125	
14th portion. . . . .	..	24	36 $\frac{1}{2}$	6 $\frac{1}{2}$	5,475	
Total solid feet for Lower Bund. . .	..	..	..	..	....	1,217,159 $\frac{1}{2}$
<b>MATTING.</b>						
For 625 feet in length of front slope. . . . .	..	625	20	..	Square feet. 12,500	Square feet.
Total square feet of matting for lower bund . . . . .	..	..	..	..	....	12,500

<i>Abstract.</i>		<i>Rs.</i>	<i>a.</i>	<i>p.</i>
7,07,785	solid feet of raising Upper Bund with earth and ramming, at Rs. 3 per 1,000 cubic feet. ....	2,123	5	8
4,940	square feet of jow matting to front slope, at 8 annas per 100 square feet .....	24	11	2
12,17,159½	solid feet of raising Lower Bund with earth and ramming, at Rs. 3 per 1,000 cubic feet. ....	3,651	7	7
12,500	square feet of jow matting to front slope, at 8 annas per 100 square feet .....	62	8	0
		5,862	0	5
Contingencies and extra establishment, at 10 per cent. .		586	3	3
Total amount for bunds across the Thurr Narra above Sirenwarree and at Khetce .....		6,448	0	0

*Bund across the Rarr Dund Feeding Channel below Kippira.*—This bund is shown on Sheet No. 8. Its object is to prevent the water escaping from the Narra into the Rarr Dund and two others connected with it. The site for the work lies between high banks not subject to inundation. The extreme length of the bund is 646 feet, its maximum thickness at top and height being respectively 27 and 13 feet. The head of water to be sustained is 9 feet. The material will be taken from both banks and from the bed of the channel in front of the work.

*Measurements.*

	No.	Length.	Breadth.	Height.	Solid feet.	Solid feet.
1st portion (south bank) ....	..	25	20½	3½	1,793½	
2nd " " ....	..	51	35	7½	13,833½	
3rd " " ....	..	71	39	8½	23,536½	
4th " " ....	..	69	40½	8½	24,451½	
5th " " ....	..	92	54	11	54,648	
6th " " ....	..	69	63	12½	54,337½	
7th " " ....	..	103	56	11½	66,332	
8th " " ....	..	116	41½	9	43,326	
9th " " ....	..	50	20½	3½	3,587½	
Total solid feet for bund in Rarr Dund feeding channel. ....	..	..	..	..	....	2,85,846½

<i>Abstract.</i>		<i>Rs.</i>	<i>a.</i>	<i>p.</i>
2,85,846½	solid feet of raising bund with earth and ramming, at Rs. 2 per 1,000 cubic feet. ....	571	11	1
Contingencies and extra establishment, at 10 per cent ..		57	2	8
Total amount for bund across the Rarr Dund feeding channel. ....		628	0	0

*Canal from the North side of the Swamp near Vuchoo to Bukkar on the Narra.*—This work is shown on Sheet No. 4. ● Its object is to afford a passage for native boats across the plain, and to drain the extensive swamp south-east of Mittrow that the land may be reclaimed. The total length of the canal is a little over  $4\frac{1}{2}$  miles. It will, until the supply of water ceases at Rorec, contain from six to ten feet of water and is sufficiently wide for two boats to pass. Its bed commences with an initial depth of four feet below the lowest level of the water in the swamp, and is carried with an uniform fall of one foot per mile to the Narra at Bukkar.

*Measurements.*

	Mean Breadth.	Mean Depth of Cutting.	Area of Section.
<b>EARTH-WORK.</b>			
For the 1st mile of excavation near Vuchoo..	$20 + 5\frac{1}{2} = 25\frac{1}{2}$	$3\frac{1}{2}$	$88\frac{1}{2}$
„ 2nd ditto .....	$20 + 7\frac{7}{8} = 27\frac{7}{8}$	$5\frac{1}{2}$	$145\frac{3}{4}$
„ 3rd ditto .....	$20 + 13 = 33\frac{1}{2}$	$8\frac{3}{4}$	$289\frac{3}{4}$
„ 4th ditto .....	$20 + 10\frac{1}{2} = 30\frac{1}{2}$	7	$213\frac{1}{2}$
Total amount of areas on 4 miles..	....	..	$737\frac{1}{2}$
For portion of 5th mile .. ● .....	$20 + 5 = 25$	$3\frac{1}{2}$	$63\frac{1}{2}$
	Sum of Areas.	Length in Feet.	Total Cubic Feet.
For 4 complete miles .....	$737\frac{1}{2}$	5,280	38,94,000
For portion of 15 miles .....	$83\frac{1}{2}$	3,340	2,78,333
Grand total cubic feet of excavation..	....	....	41,72,333

*Abstract.*

	Rs.	a.	p.
41,72,333 cubic feet of excavation, at Rs. 1-8-0 per 1,000 feet.....	6,258	7	11
Contingencies and extra establishment, at 10 per cent .....	625	13	7
Total amount for excavation .....	6,884	0	0

*General Recapitulation.*

	Rs.	a.	p.
Bund at the head of the Adhwana .....	1,442	0	0
Bund across the Narra near the head of the Owwud.....	4,085	0	0
Bund across the Owwud at Chundrjee .....	1,462	0	0
Canal from the north side of the swamp near Vuchoo to Bukkar on the Narra.....	6,884	0	0
Bunds across the four feeding channels to the Bund Dund below Chotecaree.....*	2,784	0	0
Bunds across the two feeding channels to the Sarajee Dund.....	2,471	0	0
Bunds across the Thurr Narra above Sirenwarree and below Khetee..	6,448	0	0
Bund across the Rarr Dund feeding channel below Kippira .....	628	0	0

Total amount for the works from the village of Togacha to the town of Kippira on the Narra .....

26,204 0 0

• (Signed) J. G. FIFE, Lieutenant,  
Superintendent, Narra Survey.

No. 2640 of 1853.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To the COMMISSIONER IN SIND.

SIR,—I have now the honour to transmit Lieutenant Fife's report of the survey undertaken by himself and his Assistants last season, together with a map of the country surveyed; six of the eight plans of embankments, and of a small canal recommended in his report; and an estimate of their probable cost. I also transmit Lieutenant Fife's letter, No. 209, of the 31st ultimo, with which those documents were received. Of the other two plans, one was lost out of the tin case on its way from Sukkur, and another was so torn that I returned it to be copied; those now sent are soiled, but will, I trust, answer the purpose of explaining Lieutenant Fife's projects; the two missing ones shall be sent as soon as received.\*

2. Major Baker's report dated the 14th October 1844, and Lieutenant Fife's of the 16th September 1852, afford an accurate and full description of the Narra. Major Baker's account of it relates to the upper or northern portion of the stream and extends southwards as far only as Tujjul, from which place to Togacha, a distance of some fifty miles, Lieutenant Fife, in the 6th paragraph of his report above quoted, represents the plain on either side of the river to be covered with low sand hillocks, and that there is very little culturable land.

3. At Togacha Lieutenant Fife's last year's survey commenced; the objects he had in view in undertaking it were detailed in his letter No. 57, of the 20th September 1852, transmitted to you with mine, No. 1986, of the 6th of the following month. His examination of the valley of the Narra had led him to conclude that although in places there existed considerable tracts of land capable of cultivation if only a regular supply of water were afforded to them, yet that, to reap full advantage from the outlay, it was an object of great importance to economise the expenditure of water, and to direct it towards those lands that gave promise of the best returns. He represented that below Togacha the Narra itself flows to the eastward, and is almost lost among the extensive sand-hills and dunds between it and the Eastern Desert, while to the west of it there are extensive tracts of excellent lands needing only water to render them very valuable.

4. Before he could suggest any definite plan for watering these lands, extensive levelling operations were requisite, and, as soon as the weather admitted of it, Lieutenant Fife commenced work below Togacha, and towards the end of the year his two Assistants, Lieutenant Soady and

\* A complete new set of plans have been just received, and are now sent.



Mr. Hardy Wells, joined him, and the map now transmitted shows the result of their work.

5. It will be seen that Lieutenant Fife contemplates closing altogether a portion of the eastern branch of the Narra, and thereby depriving the dunds or lakes which it feeds of their supply of water, excepting when in extraordinary floods water can well be spared, and forcing the whole body of the stream into the western branch, and towards the fertile plain extending from Mittrow to the parallel of Kippra. The reasons given by Lieutenant Fife for thus disposing of the water, appear to me to be conclusive, and the bunds across the Adhwana or eastern branch of the Narra near Togacha, across the Narra itself near the Owwud branch, and across the Owwud at Chundrajee, should undoubtedly be undertaken this season. The estimated cost of these works, aggregating Rs. 6,989, should be at once sanctioned, in order that no risk may be run of their destruction by a flood before they are fully completed. I recommend the other five works also for sanction, but the three works abovementioned should be commenced directly Lieutenant Fife can leave his present duties and proceed to the southward.

6. It is to be regretted that at the points where some of the principal bunds are required, no better material for forming them should exist than a loose drifting sand, the very worst known material for the construction of such works. Their stability will depend upon the capability of the soil on which they stand for resisting pressure. Should the soil be pervious to water and springs be forced through it below the embankment, it may possibly become a quicksand, and the embankment subside into it. No clay for puddling is procurable in the neighbourhood, but, looking at the numerous instances where embankments that effectually reclaim lands from the sea have been formed of sea-beach sand, I hope that with the great thickness Lieutenant Fife proposes to give them they will stand.

7. I trust you will concur with me in thinking that the amount of work done last season, and the great accuracy of the levelling, are very creditable to Lieutenant Fife and to his Assistants. That a number of extensive levelling circuits of from 24 to 40 miles in length can be undertaken by different parties, and that with two exceptions (easily accounted for) they should join in with a nominal error of 1 inch, is as extraordinary as it is satisfactory; the two cases, wherein the errors amounted in the one case to 3 and in the other to 6 inches, would generally be considered very fair work, and have most probably arisen from crossing marshy ground.

I have, &c.

(Signed) H. B. TURNER, Major,  
Superintending Engineer, Sind.

*Kurrachee, 12th November 1853.*

No. 453 of 1853.

REVENUE DEPARTMENT.

From the COMMISSIONER IN SIND, Kurrachee,

To the Right Honorable LORD VISCOUNT FALKLAND,

Governor and President in Council, Bombay.

MY LORD,—I have the honour to forward copy of a letter from the Superintending Engineer, with enclosed report from Lieutenant Fife, on special duty at the Eastern Narra, detailing the results of last season's operations, and submitting estimates of works immediately necessary to ensure the most economical use of the water which will be admitted as soon as the new feeder now in progress near Roree is completed.

2. The works now estimated for amount altogether to Rs. 26,204, and as the expense will be more than covered by the additional revenue of the first year, I have no hesitation in recommending the estimates for the immediate sanction of your Lordship in Council.

Vide the last paragraph of Lieutenant Fife's letter.

3. With a view to save the season, I have ventured to anticipate the order of Government by requesting Major Turner to authorise an immediate commencement of the works referred to in his 5th paragraph, at the estimated expense of Rs. 6,989, and trust that my having done so will be approved.

4. I have also requested him to furnish a rough estimate of the great canal described in paras. 14 to end of Lieutenant Fife's report.

5. Lieutenant Fife's only doubt regarding the canal in question is whether the present population of the neighbourhood would suffice to cultivate so much land. But on this point I think there can be little question, when we consider the effect of a plentiful monsoon on the Desert itself. In ordinary years there is of course no cultivation whatever, and the people subsist on the produce of their flocks and herds; but when an unusually heavy fall of rain renders the valleys between the sand-hills capable of cultivation, every man sows as much ground as he can get seed for, and reaps a good crop. On the plain described by Lieutenant Fife, the only difference will be, that what takes place in the Thurr at distant intervals of several years apart, will be of annual occurrence, till the gradual and natural increase of population renders the districts as productive and well peopled, as the tombs and traces of old canals described in these papers show it to have been in former days, before its supply of water was cut off.

6. I trust that the extent of work done, and the manner in which it has been executed, as described in Major Turner's last paragraph, will be considered as entitling Lieutenant Fife, and his Assistants Lieutenant Soady and Mr. Hardy Wells, to an expression of the approbation of Government.

7. The survey of the dunds is valuable even as a contribution to the geography of that part of Sind, and a copy of the map would probably be highly acceptable to the Geographical Society.

I have the honour to be, &c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind. \*

*Commissioner's Office, Kurrachee,  
15th November 1853.*

No. 972.

HOME DEPARTMENT.

From G. PLOWDEN, Esq.,  
Officiating Secretary to the Government of India,  
To A. MALET, Esq.,  
Chief Secretary to Government, Bombay.

SIR,—I am directed to acknowledge the receipt of your letter No. 6142, dated the 19th ultimo, requesting sanction to an additional expenditure for the prosecution of the Narra Canal in Sind.

2. In reply, I am directed to state that, under the circumstances represented, the Most Noble the Governor General in Council is pleased to sanction another advance of Rs. 50,000 for the abovementioned purpose, pending the receipt of the Honorable Court's orders on the reference made to them on the subject of the works in question.

I have the honour to be, &c.

(Signed) G. PLOWDEN,  
Officiating Secretary to the Government of India.

*Fort William, the 18th November 1853.*

No. 519 of 1854.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To the Right Honorable LORD ELPHINSTONE, G.C.H.,  
Governor and President in Council.

MY LORD,—We have the honour to acknowledge the receipt of copy of the Government Resolution No. 7080, of the 7th December 1853, with accompaniments, relative to the operations, during last season, of Lieutenant Fife, engaged on special duty at the Eastern Narra.

2. In reply, we beg to state, that the works proposed by Lieutenant Fife appear to be essentially necessary for economizing the water supplied by the Narra, and we recommend them for sanction. \*

3. We observe that there are some villages about the upper portion of the Adhwana, from which the water will be cut off, whose interests will probably be prejudiced by the arrangements. On this subject nothing is said in the papers furnished us, but the Commissioner has probably not overlooked it.

4. The result of the levelling operations appears to be very satisfactory.

5. With regard to the large canal between Mittrow and Wanga Bazar proposed by Lieutenant Fife, we cannot venture to express any decided opinion without more detailed information.

6. We desire to draw attention to the material to be used in constructing the two bunds near Togacha and near the head of the Owwud. As no better material than sand is procurable, there appears to be considerable doubt of their being permanent. As the sudden failure of bunds in such positions might produce disastrous effects, it may be doubted whether it would not be worth the expense to bring sufficient material from a distance to allow of a more substantial structure in the heart of the bund, but should the sub-soil prove to be also sand, this even might not be efficacious. Should a more substantial structure be practicable, it might be desirable, even though involving considerable extra expense.

7. We only offer these observations for the consideration of the Engineer officers on the spot, not as absolute instructions to them.

8. We regret that some unnecessary delay has occurred in submitting this report to Government by oversight on the late change of Secretaries.

We have the honour, &c.

(Signed) C. WADDINGTON, Lt. Col. Commandant,  
Chief Engineer.

„ J. SWANSON, Major.

*Bombay, Military Board Office,  
18th January 1854.*

No. 988 of 1854.

REVENUE DEPARTMENT.

From H. E. GOLDSMID, Esq.,

Secretary to the Government of Bombay,

To G. PLOWDEN, Esq.,

Officiating Secretary to the Government of India.

SIR,—With reference to the correspondence ending for the time with your letter No. 972, dated 18th November 1853, I am directed to request, that you will have the goodness to obtain the sanction of the Most Noble the Governor General of India in Council, to a further expenditure of Rs. 26,204 on the following works :—

Bund at the head of the Adhwana .....	Rs. 1,442	0	0
Bund across the Narra near the head of the Owwud .....	4,085	0	0
Bund across the Owwud at Chundrajee.....	1,462	0	0
Canal from the north side of the swamp near Vuchoo to Bukkar on the Narra .....	6,884	0	0
Bunds across the four feeding channels to the Bund Dund below Choteearee.....	2,784	0	0
Bunds across the two feeding channels to the Sarajee Dund.	2,471	0	0
Bunds across the Thurr Narra above Sirenwarree and below Khetee .....	6,448	0	0
Bund across the Rarr Dund feeding channel below Kippra ..	628	0	0
Total....	Rs. 26,204	0	0

2. These works have been proposed by Lieutenant Fife, Superintendent of the Narra Survey, and recommended by Major Turner, Superintending Engineer, the Commissioner in Sind, and the Military Board.

3. In his letter, dated 12th November 1855, submitting Lieutenant Fife's proposal, the Superintending Engineer, Major Turner, states:—

“ His (Lieutenant Fife's) examination of the valley of the Narra had led him to conclude that, although in places there existed consideration tracts of land capable of cultivation, if only a regular supply of water were afforded to them, yet, that to reap full advantage from the outlay, it was an object of great importance to economize the expenditure of water, and to direct it towards those lands that gave promise of the best returns. He represented that below Togacha, the Narra itself flowed to the eastward and was almost lost among the extensive sand-hills and dunds between it and the Eastern Desert, while to the west of it there are extensive tracts of excellent lands, needing only water to render them very valuable.

\* \* \* \* \*

“ It will be seen that Lieutenant Fife contemplates closing altogether a portion of the eastern branch of the Narra, and thereby depriving the dunds or lakes which it feeds of their supply of water, excepting when in extraordinary floods water can well be spared, and forcing the whole body of the stream into the western branch and towards the fertile plain extending from Mittrow to the parallel of Kippra. The reasons given by Lieutenant Fife for thus disposing of the water appear to me to be conclusive.”

\* \* \* \* \*

4. The following extracts from Lieutenant Fife's reports on the Eastern Narra from Togacha to Kippra in the Hyderabad Collectorate, will show the importance of the proposed works in a financial point of view :—

“ The quantity of water contained by the dunds, when they were surveyed during the cold season, has been calculated from their areas and by means of soundings taken in them. The result of this calculation shows that they

“ contained the enormous quantity of 6,650,000,000 cubic feet. In Colonel Cautley’s report on the Ganges Canal, it is assumed as an axiom, that a discharge of one cubic foot per second constant is sufficient for the cultivation of 350 beegahs of land. Now, a discharge of one cubic foot per second constant would give 31,536,000 cubic feet in a year. The quantity of water contained in the dunds would therefore have been sufficient for the cultivation of about 74,000 beegahs, which, assessed at the rate of Rs. 1½ per beegah, would have yielded a revenue of Rs. 1,11,000. The revenue actually yielded by the dund lands was for the season 1851-52 Rs. 855, and for the season 1852-53 Rs. 464. It at first seems strange that, yielding so small an amount of revenue, the dunds should have ever been so highly thought of by the Natives, but this is susceptible of explanation. The Narra’s natural supply of water is precarious; the dunds are capacious; for, years after being filled by a flood, they would continue to yield grain and fish in quantities, not large perhaps considering the extent of country, but large enough to feed and give employment to the people: when the supply of water in the Narra failed, the dunds still continued to yield. The revenue obtained during any one season was, perhaps, never great, though that arising during many seasons from the effect of one flood may have been considerable. But it could scarcely, under even the most favourable circumstances, have been proportionate to the quantity of water used. It therefore appears, that so long as there is need of water elsewhere, it would not be advisable to supply the dunds. It will be seen in the following pages that while the works proposed for cutting off the dunds from the river are calculated to completely exclude the water during ordinary floods, during great floods, when there would be a superabundance of water, the most extensive and valuable of the dunds will receive a supply by the overflowing of the Narra. \* \* \* I feel satisfied, after the most mature consideration, that when the wastage of the water is prevented in the manner proposed, we shall have the country under cultivation from Mittrow to Wanga Bazar, and instead of the revenue arising from an occasional natural flood, such as occurred in 1852, amounting to Rs. 20,000, Government would realize upwards of a lak. Indeed the cost of the works would be far more than covered in a single season.”

5. In order that a season might not be lost, Mr. Frere has already

Bund at the Head  
of the Adhwana for. . Rs. 1,442  
Bund across the  
Narra near the Head  
of the Owwud . . . . , 4,085  
Bund across the  
Owwud at Chindrajee , 1,462

Rs. 6,989

authorised the construction, at the estimated cost of Rs. 6,989, of three of the works mentioned in the 1st paragraph of this letter, and this Government have expressed their approval of his proceedings.

I have the honour, &c.

(Signed) H. E. GOLDSMID,  
Secretary to Government.

*Bombay Castle, 18th February 1854.*

No. 162 of 1854.

## PUBLIC WORKS.

## REVENUE DEPARTMENT.

To the SECRETARY TO THE MILITARY BOARD, Bombay.

SIR,—I have the honour to report that I have inspected Lieutenant Fife's works near Roree, and have examined his office books and accounts. The new head for the Narra has been commenced within about 300 yards of the bank of the river; the ground has been opened for two miles; the first mile has been very nearly completed, with the exception of the removal of ramps left for wheeling up the soil; the second mile is about half finished.

2. Lieutenant Fife has had great difficulty in procuring sufficient labourers; by great exertions he has collected upwards of 1,200, and 320 carts, which do the work of 1,000 men: he could, however, with advantage employ 3,000 men instead of 1,200. At first the work was unpopular, but the number of men has for some time past been steadily increasing, and as Lieutenant Fife has hopes, in addition to obtaining a greater number of people, of being able to get contractors to undertake portions, I trust the progress will hereafter be greater than it has been.

3. All the cutting completed has been done by task-work; each labourer and each cartman has a certain fixed quantity of work measured out to him, decreasing in quantity in proportion to the depth; towing paths are formed on each side, and the surplus earth thrown beyond, and levelled at a given height.

4. The labourers are allowed to use barrows, or baskets, but they prefer the former; Lieutenant Fife has made up 2,000, and each man pays a fixed rate per diem for the use of a barrow, which is credited towards defraying the expense incurred in making them up.

5. The whole arrangements Lieutenant Fife has established are extremely perfect, and such as effectually to counteract the result of laziness on the part of the labourers, and to check fraud.

6. Lieutenant Fife's accounts are kept in the established form, and are brought up to the latest date; and I was satisfied that under his excellent management the work will be completed for the estimated rate, which, as the Board is aware, is extremely low, viz. 4 annas per 100 cubic feet, the depth of cutting being 17 feet, and the breadth above 200 feet, the rate including the cost of forming tow-paths and of levelling the banks.

I have the honour, &c.

(Signed) H. B. TURNER, Major,  
Superintending Engineer, Sind.

*Mustee-ka-Tanda, 28th January 1854.*

No. 1658 of 1854.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

We have the pleasure to submit the foregoing very satisfactory report of the progress of the Narra Canal works.

(Signed) C. WADDINGTON, Lieut. Colonel,  
Chief Engineer.

J. SWANSON, Major.

*Bombay, Military Board Office,  
18th February 1854.*

No. 1130 of 1854.

REVENUE DEPARTMENT.

TO THE MILITARY BOARD.

*Resolution of Government, dated the 3rd March 1854.*

Government have derived much satisfaction from this report, and consider the information it gives very creditable to Lieutenant Fife.

No. 276.

HOME DEPARTMENT.

From G. COWPER, Esq.,

Under-Secretary to the Government of India,

To H. E. GOLDSMID, Esq.,

Secretary to the Government of Bombay.

SIR,—I am directed to acknowledge the receipt of your letter No. 988, dated the 18th ultimo, and in reply to convey the sanction of the Most Noble the Governor General in Council to a further expenditure of Rs. 26,204 on works connected with the Narra Canal in Sind, pending the receipt of the Honorable Court's orders on the reference made to them on the subject of the work in question.

I have the honour to be, &c.

(Signed) G. COWPER,

Under-Secretary to the Government of India.

*Fort William, the 10th March 1854.*



No. 44 of 1854.

REVENUE DEPARTMENT.

\* From the COMMISSIONER IN SIND,

To the Right Honorable LORD ELPHINSTONE, G.C.H.,

Governor and President in Council, Bombay.

MY LORD,—I have the honour to report, that when at Roree, I visited the works on the Narra supply channel, now in course of excavation under Lieutenant Fife, Engineers, and was glad to find that magnificent work in full progress ; all the arrangements appeared, as far as I could judge, most creditable to Lieutenant Fife's judgment and ingenuity, and likely to ensure the completion of the work at the least possible cost to Government.

2. The channel commences just above the town of Roree, and, after skirting the rocky hills through which the river forces itself at Roree, will fall into the Narra at a point nearly thirteen miles from that town.

3. The channel is 16 feet deep and nearly 206 feet wide at top, the sides standing at a slope of 1 in  $1\frac{1}{2}$ . There is a berm, or towing path, 15 feet wide, on each side ; instead of the excavated soil being piled in irregular and unsightly heaps, as is the mischievous practice on every other canal in Sind, so that the sides continually fall in and a large portion of the best ground is wasted, the excavated earth is distributed in two uniform platforms, or terraces, on either bank, generally about 8 feet above the natural soil.

4. These form efficient barriers against the highest inundation, which occasionally lays the whole country above Roree under water, bursting the banks of the canals which run through low ground and washing vast quantities of silt into them.

5. These terraces will also, in consequence of their security from submersion, and the vicinity of water, form admirable garden ground, for which there is a great demand near Roree ; and the revenue from them will form a considerable addition to the returns originally calculated on.

6. The method of carrying on the excavation is also new to the country, and a decided improvement on that heretofore in use in such shallow and deep excavations.

7. The usual mode of excavation in Upper Sind is either by " Cherh " or Statute labour, or by contract.

8. Under the former system every cultivator interested, or supposed to be interested in the work, is obliged to contribute a quota of labourers in proportion to the extent of his cultivation, and all hands work till the task is finished, receiving, if the Government be liberal, a ration of grain sufficient to feed the workman, but not sufficient to induce him to delay the completion of his task.

9. Contract work is taken by guessing or roughly measuring the task.

10. In either case there are innumerable devices to make the work done seem more than it really is, and to palm off as finished an incomplete task.



11. In both modes of working the excavated soil is sometimes moved in baskets or by a machine called a "keen," a board drawn by oxen, which, like a gigantic hoe trailed over the ground, scrapes up the loose earth before it, and moves it after the oxen, as far as may be required, when it is lifted; so as to leave the earth behind it, and returns for a fresh load.

12. But more commonly the only implement used is the "poura," a hoe with a blade as large as a good size shovel and a short handle. The labourer fills the blade by striking it into the soft soil, and then, by a jerk, throws the shovelful upwards and behind him to the distance of several feet. If the soil is to be moved far, one man stands behind the other, and each pitches the earth from his poura so as to fall at the feet of the man in his rear, who, in like manner, passes it on to the next man behind him; in this way a string of fifty men may sometimes be seen moving earth, from the bottom of a deep and wide canal, up the sides, and over the high spoil-banks, which rise above the edges of the canal.

13. So expert are the Upper Sind labourers at the use of the poura, that where the distances to which earth is moved are short, the method above described is an economical way of applying their labour; but for distances such as are required in the Narra excavation, such a mode of working becomes very wasteful.

14. The method adopted by Lieutenant Fife is as follows:—

15. The channel is divided into portions or lots of 100 feet in length; at the extremity of each lot a ramp or slope 10 feet wide is left for ascent and descent; the earth between the ramps is then removed in regular layers or "floors"  $1\frac{1}{2}$  foot thick, till the requisite depth is attained, when the sides of the channel are cut to a slope of 1 in  $1\frac{1}{2}$  and the ramps are removed. By this method sufficient room is allowed between the ramps to measure out the work, while the ramps occurring at convenient intervals, and being kept at an easy slope, the soil is got out of the excavation with great facility.

16. The men are divided into gangs of ten each, and the work is marked out in daily tasks for each gang, and then, if necessary, subdivided into individual tasks. The quantity in each task, of course, varies according to the depth of the excavation and the distance to which the earth has to be carried.

17. The men work when and how they please, no restriction being placed on them, provided the task be done by a fixed hour in the evening.

18. The work done is then so measured, by means of ropes and gauges, that any fraud in the excavation is all but impossible, and a tin ticket, marked to denote the overseer or measuring Moonshee who issues it, is given to every man who has completed his task. If the task be incomplete no ticket is given, nor can another day's work be assigned to the defaulter till his unfinished task is completed. The tickets are cashed for wages on presentation to the Shroffs, and in this way the troublesome muster rolls of many hundreds of workmen who are constantly changing are dispensed with.

19. The most remarkable feature in the system is, however, the introduction of wheeled carriage for the removal of the excavated soil.

20. The small two-bullock cart made entirely of wood, peculiar to Upper Sind, is used to remove the layers near the surface, and from its lightness, lowness, and extreme simplicity of make, is found to answer better than our larger, more expensive, and more cumbrous carts. As the excavation deepens the carts cease to work to advantage, and wheel barrows are employed. They are made and repaired on the spot by Native workmen, principally Marwarrees, and cost about Rs. 4½ each. At first it was difficult to persuade the men to use them, but when they had once learnt their utility, they positively refused to work without them, even after the daily task assigned to a barrow man had been increased by one-sixth above that of a man working in any other way.

21. The annexed rough sketch may give a better idea than the above description of the difference in the mode of working.

22. Though their tasks vary from 65 to 85 cubic feet per man, and the average is 75 cubic feet, still a man can earn 2½ annas per diem, good wages where the finest wheat flour is considered dear at a rupee per 80 lbs. Many get meat, of which all Sindees are very fond, and a cast cart bullock is generally converted into beef, and devoured by the workmen.

23. It is difficult to get the labourers to remain long steadily at work canal-digging, which lasts from December to April. Ploughing, seed time, and harvest of both the autumn and winter crops, carry off hundreds at a time, who return when the work which took them away is over; and even without such inducement, when a man has earned a few rupees, he goes away and idles till it is spent. Singularly enough, the greatest numbers attend, and most work is done in the hottest weather. There is then but little field-work going on, and farm-work is scarce. But the fiery hot wind, coming over the white limestone range of the Alore hills, renders it almost death to an European to be long exposed to the sun. Even the Sindees cannot stand it; so they sleep all day, and work in the excavation at night and during the long twilight; and, by the excellent arrangement of his task-work, Lieutenant Fife is able to superintend them, and get even more work than at the best working season.

24. Good as are the wages which a man can earn, Lieutenant Fife has not yet succeeded in getting anything like the number of men he requires and could readily employ. The greatest number he has ever had has been—346 carts in February 1854, and 2,187 wheel-barrows, &c. in July last; the smallest number, 48 carts and 116 wheel-barrows in October last. He could readily, if he could get them, find work for 3,000 wheel-barrow men and 1,000 carts, and, with a little previous notice, twice that number.

25. The present average weekly expenditure is Rs. 2,100.

26. Two miles of the Channel are well advanced towards completion, and the third is commenced. It is possible the work may be completed in time for

the inundation of 1855; but unless the number of workmen procurable should greatly increase beyond what has been hitherto usual, the season of opening will be deferred.

27. During the whole of last hot weather Lieutenant Fife attended daily at the works, though, from the impossibility of getting shelter for himself on the Roree side, he was forced to live at Sukkur, crossing the Indus at its highest flood twice daily. This involved much exposure to the sun and a great amount of bodily fatigue; and I am respectfully of opinion that the zeal evinced by Lieutenant Fife in the execution of the work entrusted to him is not less deserving the approbation of your Lordship in Council than the ability manifested in designing it.

28. He has now reduced the execution of the work to a system simple and easily understood by the people, and capable of exact control by any European of ordinary intelligence and education; and I would very strongly recommend that such subordinate assistance may be placed at the disposal of the Superintending Engineer as may enable him to relieve Lieutenant Fife from the very laborious but perfectly routine duty of checking the excavation, and may allow of his attending to the design of some of the many important works which will be required further down the line, and elsewhere within the range of Major Turner's division.

29. Works like that which I have endeavoured to describe, conducted on the plan followed by Lieutenant Fife, have an importance far beyond the direct benefit they confer on the country and the public revenue, by affording water to what have heretofore been arid wastes, and by converting vast tracts of almost desert country into corn fields. They teach the people habits of order, regularity, and steady industry; they encourage them to economize their labour by the use of the simpler mechanical appliances; and they accustom them to ready money payment and to independence of the money-lender. In every way the indirect civilizing tendencies of such works are hardly less valuable than their direct financial results.

I have the honour to be, &c.

(Signed) H. B. E. FRERE,  
Commissioner in Sind.

*Camp, Punnah, 6th February 1854.*

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No. 1718 of 1854.

TERRITORIAL DEPARTMENT, REVENUE.

To the COMMISSIONER IN SIND.

*Resolution of Government, dated the 1st April 1854.*

Mr. Frere to be told that the information he has placed before Government

is highly creditable to Lieutenant Fife, and has afforded Government much satisfaction.

2. Copy to be sent to the Military Board, and their opinion requested on the Commissioner's proposal in para. 28.

No. 3508 of 1854.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

To the Right Honorable LORD ELPHINSTONE, G.C.H.,  
Governor and President in Council.

MY LORD,—We have the honour to acknowledge the receipt of copy of the Resolution passed by Government under date the 1st April 1854, No. 1718, regarding the result of the visit of the Commissioner in Sind to the works on the Narra Supply Channel.

2. With reference to the 2nd paragraph of the Resolution, we beg to state that we entirely concur in Mr. Frere's observations, and, if the Superintending Engineer will inform us of what assistance is required, we will, if possible, comply.

3. A copy of the 28th paragraph of Mr. Frere's letter, and of the Government Resolution, and of this reply, will be communicated by us to Major Turner, the Superintending Engineer.

4. The two sketches are herewith returned.

We have the honour to be, &c.

(Signed) C. WADDINGTON, Colonel,  
Chief Engineer of Public Works.

„ J. SWANSON, Major.

*Bombay, Military Board Office, 12th April 1854.*

No. 70 of 1854.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To the SUPERINTENDING ENGINEER IN SIND.

SIR,—I have the honour to acknowledge the receipt of your communication No. 529, of the 11th instant, and accompaniments, and with reference to the 3rd paragraph of the Military Board's letter No. 519, of the 18th January, to state that the villages of Togacha, Badawarree, and Ubrow, and others situated near the Adhwana, and from which the water will be cut off by the construction of the bunds across the Adhwana and Narra, are mere hamlets.

The houses are constructed of brushwood only, and are few in number. The people live by their flocks, and, except in the dunds, there is little or no culturable land for them to cultivate. The beds of the dunds they will still be able to cultivate as hitherto whenever rain falls.

2. In respect to the 6th and 7th paragraphs of the Military Board's letter, suggesting a more substantial construction for the dunds across the Adhwana and Narra, I beg to state that the beds of the channel are composed entirely of sand, and that soil can only be found in patches at a considerable distance from the sites. The transport of the latter material would therefore prove very expensive, and a great width of bund would, I am afraid, still be indispensable. When considering the subject of these bunds before designing them, it occurred to me that percolation through and under the bund to any mischievous extent might be stopped by carrying a sheet of planking, well sunk into the bed of the channel, along the whole length of the bund. This, till the wood decayed, would, I think, be very effectual, but it would of course greatly increase the expense. After a great deal of consideration, I came to the conclusion that with the moderate head of water of nine feet, bunds of sand with a covering of clay, which would defend them from the action of the wind and check the percolation of the water, would, if made of great thickness, be effectual and economical. In designing the bunds, I assumed that the percolation of water arising from a difference in level or head of one foot would not disturb the particles of sand in a bund fifteen feet thick, provided there was any top weight to keep the lower particles steady. I assumed that the percolation through fifteen feet of sand would be too much retarded to be injurious. For every foot of water head I added fifteen feet to thickness of the bund; for a head of 9 feet, therefore, I gave the bunds a thickness of 135 feet. The thickness at base was of course greater by the addition of the slopes, and altogether 207 feet.

3. I am sanguine as to these bunds proving equal to the trial, and I see every reason to conclude that they will become stronger every season. The bunds being secured from the action of the wind by the coating of clay, the wind, by causing the loose sand to drift up the channels against the back of the bunds, will strengthen them. As soon as the muddy Indus water is admitted into the Narra, the particles of clay will be deposited in the bund; whenever the water percolates through, as soon as the bunds are constructed, jungles will rapidly spring up both in front and in rear, and even on the bunds themselves. The jow-tree grows luxuriantly in sand so long as there is moisture, and as the whole valley is covered with this tree, the seed is conveyed down with the water and scattered wherever the water can go.

I have the honour to be, &c.

(Signed) J. G. FIFE, Lieutenant,  
Superintendent, Narra Works.

*Camp Roree, 11th March 1854.*

No. 690 of 1854.

**PUBLIC WORKS.****REVENUE DEPARTMENT.****To the ASSISTANT COMMISSIONER IN CHARGE.**

SIR,—With reference to paras. 3, 6, and 7 of the Military Board's report, No. 519, of the 18th January last, and to the 4th paragraph of Government Resolution No. 987, of the 18th ultimo, transmitted with the Commissioner's endorsement No. 574, of the 3rd instant, I have the honour to transmit copy of a letter from Lieutenant Fife, No. 70, of 17th instant.

2. There are, as you know, no permanent villages on the banks of the Narra; the uncertainty of a supply of water for many years past has compelled the frequent emigration of the whole population. When the Narra has come down, or when there has been water in the dunds, a scanty population has returned to it, and the available pasturage and culturable land turned to account; but under such circumstances the most rude temporary houses are all that exist, and there cannot be a question that to the whole population the restoration of the stream and its being turned on the best lands cannot be otherwise than a great blessing; and as the villages, such as they are, are generally on the summit of sand-hills, the bursting of the proposed bunds can do them no injury.

3. I gave the question of the construction of the bunds the fullest consideration, and determined that the difference of expense between using the indifferent material found on the spot, and bringing that of better quality from the nearest place at which it was procurable, was so great, as to justify an experiment being made as to the possibility of constructing a durable bund of such sand. I am quite sensible of the risk the Board point out, indeed in handing up Lieutenant Fife's project I drew the Commissioner's attention to it; but when the distance of good material from the point where it is required is considered, and when it is remembered that on loose drift sand carts cannot work, and that the soil required must, like the top dressing of the bund now being made, be brought on camels, the difference of expense can be imagined. If the bunds stand the first year, I think it very probable the bed of the river will be almost if not wholly filled up by drift.

4. One or at most two of these bunds will be completed this season, and if they should fail, the loss to Government by the experiment will not be great.

I have the honour to be, &c.

(Signed) H. B. TURNER, Major,  
Superintending Engineer, Sind.

*Goojah, 31st March 1854.*



No. 106 of 1854.

REVENUE DEPARTMENT.

From the ASSISTANT COMMISSIONER IN CHARGE, SIND,  
To the Right Honorable LORD ELPHINSTONE, G.C.H.,  
Governor and President in Council, Bombay.

MY LORD,—In reference to the 4th paragraph of the Government Resolution as per margin, I have the honour to submit copy of the accompanying letter from Major Turner, Superintending Engineer, on the subject of the proposed bunds across the Adhwana and Narra.

No. 987, of 18th February 1854, forwarding observations by the Board on bunds proposed by Lieutenant Fife across the Narra, &c.

No. 690, of 31st March, with enclosure from Lieutenant Fife.

I have the honour, &c.

(Signed) B. H. ELLIS,  
Assistant Commissioner in Charge.

*Karrachee, 5th April 1854.*

No. 3896 of 1854.

PUBLIC WORKS.

TERRITORIAL DEPARTMENT, REVENUE.

REPORT.—These letters show that the question noticed by us had received full consideration.

2. We are satisfied with the decision of Lieutenant Fife and Major Turner.

(Signed) C. WADDINGTON, Colonel,  
Chief Engineer.

*Bombay, Military Board Office,  
22nd April 1854.*

„ J. SWANSON, Major.

No. 537.

REVENUE.

HOME DEPARTMENT.

From G. COWPER, Esq.,  
Under-Secretary to the Government of India,  
To H. E. GOLDSMID, Esq.,  
Chief Secretary to the Government of Bombay.

SIR,—With reference to correspondence noted in the margin, I am directed by the Most Noble the Governor General of India in Council to forward, for the information of the Government of Bombay, the accompanying extract (paragraphs 1 to 9) from a despatch from the

Letter from Government of Bombay, No. 7415, dated 15th November 1852.  
Do. to do., No. 17, dated 12th January 1853.

Letter from Government of Bombay, No. 6142, dated 19th October 1853.

Do. to do., No. 972, dated 18th November 1853.

Honorable the Court of Directors, No. 7, dated 15th March last, sanctioning the execution of the project for supplying the Narra Channel in Sind with water from the Indus.

I have the honour to be, &c.

(Signed) G. COWPER,

Under-Secretary to the Government of India.

*Fort William, the 12th May 1854.*

*Extract from a Despatch from the Honorable the Court of Directors to the Government of India, in the Revenue Department, No. 7, dated the 15th March 1854.*

1. We now reply to the letters of the dates noted in the margin, which

Part of para. 39 of India Public Letter, dated 22nd July (No. 49) 1853.

28th October (No. 78) 1853.

18th November (No. 86) „

Bombay Revenue letter, dated 24th May (No. 75) 1852.

4th February (No. 21) 1853.

relate to a project for supplying the Narra Channel in Sind with water from the Indus.

2. The Narra is a side overflow channel of the Indus, and is well defined. It runs in a southerly direction from above Roree through Sind to the sea at Cutch, a distance of about three hundred miles. It varies in breadth from 200 to

1,300 feet, and is in places divided into two branches.

3. The valleys in its course are occupied by numerous “dunds” or lakes,

Para. 7, Lieutenant Fife's Report.

amounting to nearly 400, and some of these are three miles in length and a mile in breadth.

There is every reason to believe that the Narra was formerly constantly supplied with water from the Indus, though of late years it has only received this supply on the occasion of high floods.

4. Whether the obstruction to the ancient channels of supply was occasioned by the operations of nature or the erection of artificial “bunds” has been a point in dispute. Major Baker, in a report dated 14th of October 1844, expressed his opinion that the obstruction was the result of the silt deposits which are left by floods on the margin of all large rivers.

5. This view is corroborated by Lieutenant Fife, in his report dated the 16th September 1852, to whom the duty of effecting a detailed survey of the Narra was entrusted, and who appears to have executed his task with judgment and care.

6. It was proposed by the Bombay Government to supply this channel with water by a cutting near Roree, the estimated cost of which is Rs. 4,77,805. You have sanctioned the commencement of the project, and an expenditure of Rs. 100,000 in anticipation of our orders.

7. All authorities, civil and professional, are unanimous in favour of the work, and in para. 46 of Lieutenant Fife's report the return that would be derived immediately on the opening of the Narra is estimated at Rs. 52,000 per annum, or 11 per cent. on the total outlay of Rs. 4,77,805. And this return would probably be liable to considerable eventual increase, as the traditional reports of the country indicate a revenue from the formerly cultivated valley of the Narra varying from two to six lacs of Rupees.

8. The report of Lieutenant Fife appears conclusively to show that no inconvenience would result from the abstraction of so large a body of water from the Indus—a point of great importance; and it is satisfactory to find that the conclusions of Lieutenant Fife are generally concurred in and supported by Major Turner, the Superintending Engineer, who has specially reported on the subject. That officer, in the last paragraph of his report, observes—"I have full confidence that if Lieutenant Fife be entrusted with the work, his rates will be found ample, and the undertaking will be completed within the estimated cost."

9. The careful consideration which the work has received from competent judges, the numerous advantages that may be expected to accrue from it, and the beneficial results that have attended similar works in other parts of India, leave us no ground to doubt that the project is deserving of our cordial approval.

(True extract)

(Signed) G. COWPER,

Under-Secretary to the Government of India.

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No. 267 of 1855.

PUBLIC WORKS.

REVENUE DEPARTMENT.

To Lieutenant Colonel H. B. TURNER,  
Superintending Engineer, Sind.

SIR,—I have the honour to forward a fresh section and estimate for forming the supply channel to the Eastern Narra on a slightly modified design, which has suggested itself to me while considering the question of the water supply for the Mittrow Canal, the project for which was submitted to you with my report No. 272, dated 22nd ultimo.

2. The only part of that project which struck me as being imperfect, was the chance of irregularity in the supply of water during the months of December and January each year, though I knew that, if necessary, that risk might be avoided by some further expenditure for deepening the supply channel at Roree. Since submitting my report, however, I have made some careful calculations, and find that by a very slight modification on the original design of the supply channel,

we may ensure the requisite supply of water in December and January, during which it might become irregular. I find that by making the channel  $1\frac{1}{2}$  feet deeper at the head, and slightly reducing the width, and fall per mile, the same body of water may be drawn off from the Indus during the inundation, and that a greater quantity may be drawn off during the cold weather, than we should obtain by means of the channel as originally designed.

3. The proposed modification will give us less earthwork, but more rock-cutting, than in the original design, and I look upon this as rather an advantage than otherwise, because it will enable us to keep the channel, when it is exposed to the action of the stream, in better order. The velocity of the stream will, moreover, be somewhat less than that calculated on in the original design, from the reduction of the fall from 1.38 to 1 foot per mile.

4. I have carefully estimated the cost of the modified design, and find that it corresponds as nearly as possible with the original sanctioned estimate. I have been obliged to allow high rates for the additional excavation and rock-cutting in the first four miles, as, at the increased depth proposed for the bed, springs are met with, which render the work extremely laborious and expensive.

5. As Captain Kirby is progressing rapidly with the excavation in the eighth, ninth, and tenth miles, I request the favour of your obtaining an early sanction to the proposed modification, in order that the width and depth of the excavation may be made to suit the alteration in the design.

I have the honour to be, &c.

(Signed) J. G. FIFE, Lieutenant,  
Superintendent, Narra Works.

*Camp, Kharwar, 19th December 1855.*

No. 30 of 1856.

#### PUBLIC WORKS DEPARTMENT.

Transmitted for the approval of the Chief Engineer of Public Works. Lieutenant Colonel Turner entirely approves of the proposed modification, as it will decrease the chance of the bed being injured, and increase the supply of water during the cold season.

(Signed) H. B. TURNER, Lieut. Colonel,  
Superintending Engineer.

*Shikharpoor, 5th January 1856.*

No. 618 of 1856.

**PUBLIC WORKS DEPARTMENT.**

To the Right Honorable LORD ELPHINSTONE, G.C.H.,  
Governor and President in Council.

MY LORD,—I have the honour to submit a letter from Captain Fife, No. 267, of the 17th December, proposing certain modification in the longitudinal and transverse sections of the supply channel to the Eastern Narra, together with the estimate and sections therein referred to, and request the sanction of your Lordship in Council to the alterations proposed by Captain Fife.

2. The estimated cost of carrying out the present design is Rs. 4,76,426, being Rs. 1,379 less than the amount (Rs. 4,77,805) originally sanctioned for the work in the Honorable Court's despatch to the Government of India, No. 7, of the 15th March 1854.

I have the honour to be, &c.

(Signed) C. WADDINGTON, Major General,

19th January 1856.

Chief Engineer of Public Works.

No. 258 of 1856.

**PUBLIC WORKS DEPARTMENT.**

To the SECRETARY TO THE GOVERNMENT OF INDIA.

SIR,—In their despatch\* to the Government of India No. 7, dated the 15th March 1854, the Honorable the Court of Directors sanctioned the execution of a project recommended by this Government for supplying the Narra channel in Sind with water from the Indus.

2. I am now desired to bring to the notice of the Government of India the circumstance, that from careful calculations made by Captain Fife, the officer employed in carrying out the above project, some slight modification on the original design has recently suggested itself to that officer, as being necessary in order to obviate all possible risk of irregularity in the supply of water during the months of December and January in each year.

3. Lieutenant Fife has written on the subject as follows :—

“ I find that by making the channel  $1\frac{1}{2}$  feet deeper at the bed and slightly reducing the width and fall per mile, the same body of water may be drawn off from the Indus during the inundation, and that a greater quantity may be drawn off during the cold weather than we should obtain by means of the channel as originally designed.

\* Extract paras. 1 to 9 from this despatch was forwarded to this Government with Mr. Under-Secretary Cowper's letter No. 537, dated the 12th May 1854.

“ The proposed modification will give us less earthwork, but more rock-cutting, than in the original design, and I look upon this as rather an advantage than otherwise, because it will enable us to keep the channel, when it is exposed to the action of the stream, in better order. The velocity of the stream will, moreover, be somewhat less than that calculated on in the original design, from the reduction of the fall from 1·38 to 1 foot per mile.”

4. The Superintending Engineer in Sind having expressed his entire approval of the proposed modification, which he is of opinion will decrease the chance of the bed being injured, as well as increase the supply of water during the cold season, and as it has also been approved by the Chief Engineer of Public Works, it has been sanctioned by this Government.

5. With the modification now reported, the estimated cost of carrying out the project of restoring water to the Narra Channel will be Rs. 4,76,426, or Rs. 1,379 less than the amount (Rs. 4,77,805) originally sanctioned in the Honorable Court's despatch above referred to.

I have the honour to be, &c.

(Signed) W. HART,  
Secretary to Government.

*Bombay Castle, 9th February 1856.*

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No. 1086.

REVENUE.

PUBLIC WORKS DEPARTMENT.

From Lieutenant Colonel W. E. BAKER,  
Secretary to the Government of India.

To W. HART, Esq.,  
Secretary to the Government of Bombay.

SIR,—I am directed to acknowledge the receipt of your letter No. 258, dated the 9th instant, and in reply to state, that under the circumstances there-in represented, the Most Noble the Governor General in Council approves of the modification in the original design for supplying the Narra Channel in Sind with water from the Indus, authorised by the Government of Bombay, at an estimated cost of Rs. 4,76,426, being Rs. 1,379 less than the amount sanctioned for this project by the Honorable Court of Directors, in their Revenue despatch to the Government of India No. 7, of the 15th March 1854.

I have the honour to be, &c.

(Signed) W. E. BAKER, Lieut. Colonel,  
Secretary to the Government of India.

*Fort William, the 28th February 1856.*

*Statement showing the Annual Revenue of the Narra Districts, from the  
Conquest up to the Years 1855-56.*

No.	Year.			Kurreef.			Rubbee.			Other Sources.			Grand Total.		
				Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
1	Rubbee & Kurreef	1254	A.D. 1843-44	328	7	6	238	5	8	281	9	8	848	6	10
2	Ditto	1255	" 1844-45	2,378	14	11	529	8	11	...	...	...	2,908	7	10
3	Ditto	1256	" 1845-46	1,088	13	11	1,546	7	7	21	0	0	2,656	5	6
4	Ditto	1257	" 1846-47	2,360	2	11	606	10	3	6	6	5	2,973	13	7
5	Ditto	1258	" 1847-48	291	3	3	800	1	8	4	12	0	1,06	0	11
6	Ditto	1259	" 1848-49	16	9	11	714	15	2	...	...	...	731	9	1
7	Ditto	1260	" 1849-50	186	13	6	152	13	7	7	10	0	347	5	1
8	Ditto	1261	" 1850-51	144	12	6	51	13	9	22	5	0	218	15	3
9	Ditto	1262	" 1851-52	578	14	1	80	14	0	204	2	6	863	14	7
10	Ditto	1263	" 1852-53	620	0	10	7,677	0	0	108	2	6	8,405	3	4
11	Ditto	1264	" 1853-54	980	3	4	19,550	1	2	398	7	5	20,928	12	1
12	Ditto	1265	" 1854-55	1,885	1	3	52,995	9	5	1,028	5	9	55,909	0	5
13	Ditto	1266	" 1855-56	2,750	9	6	78,226	1	11	471	12	0	81,448	7	5

This statement shows the revenue derived from land watered from the Narra from 1843 to 1856. The increased revenue from 1854-55 is directly attributable to the Narra bunds. The falling off in the revenue to the amount of Rs. 71,000 for Rubbee of 1856-57 is owing to the very unfavourable nature of the inundation of the previous season.

(Signed) JOHN JACON, Lieutenant Colonel,  
Acting Commissioner in Sind.









